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(54) **INTELLIGENT CONTROLLED CHARGING STATIONS**

(71) Applicant: **INTERNATIONAL BUSINESS MACHINES CORPORATION**, Armonk, NY (US)

(72) Inventors: **Vikram Rengarajan**, Irving, TX (US); **Subil Mathew Abraham**, Lewisville, TX (US)

(73) Assignee: **INTERNATIONAL BUSINESS MACHINES CORPORATION**, Armonk, NY (US)

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H04L 67/125	(2022.01)
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CPC ***G06Q 30/0238*** (2013.01); ***G05F 1/66*** (2013.01); ***G06Q 50/06*** (2013.01); ***H04L 67/125*** (2013.01); *G06Q 20/20* (2013.01)

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CPC .. H04L 67/125; G06Q 20/20; G06Q 30/0238; G06Q 50/06; G05F 1/66

See application file for complete search history.

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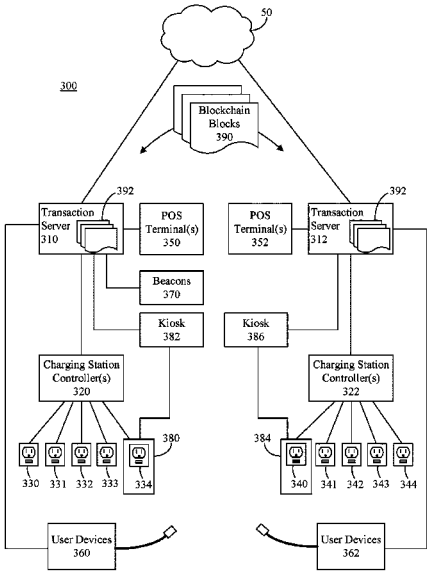
Primary Examiner — Crystal J Barnes-Bullock
(74) *Attorney, Agent, or Firm* — Cuenot, Forsythe & Kim, LLC

(57) **ABSTRACT**

An in-store customer transaction can be detected. Power charging credits can be assigned to the customer based, at least in part, on the in-store customer transaction. A charging station can be activated for the customer. Whether an amount of energy consumption by at least one user device of the customer from the charging station has reached a threshold value can be determined. The threshold value can be based, at least in part, on the charging credits assigned to the customer. Responsive to determining that the energy consumption by the at least one user device of the customer from the charging station has reached the threshold value, the charging station can cease or reduce power being delivered by the charging station to the at least one user device of the user.

20 Claims, 7 Drawing Sheets



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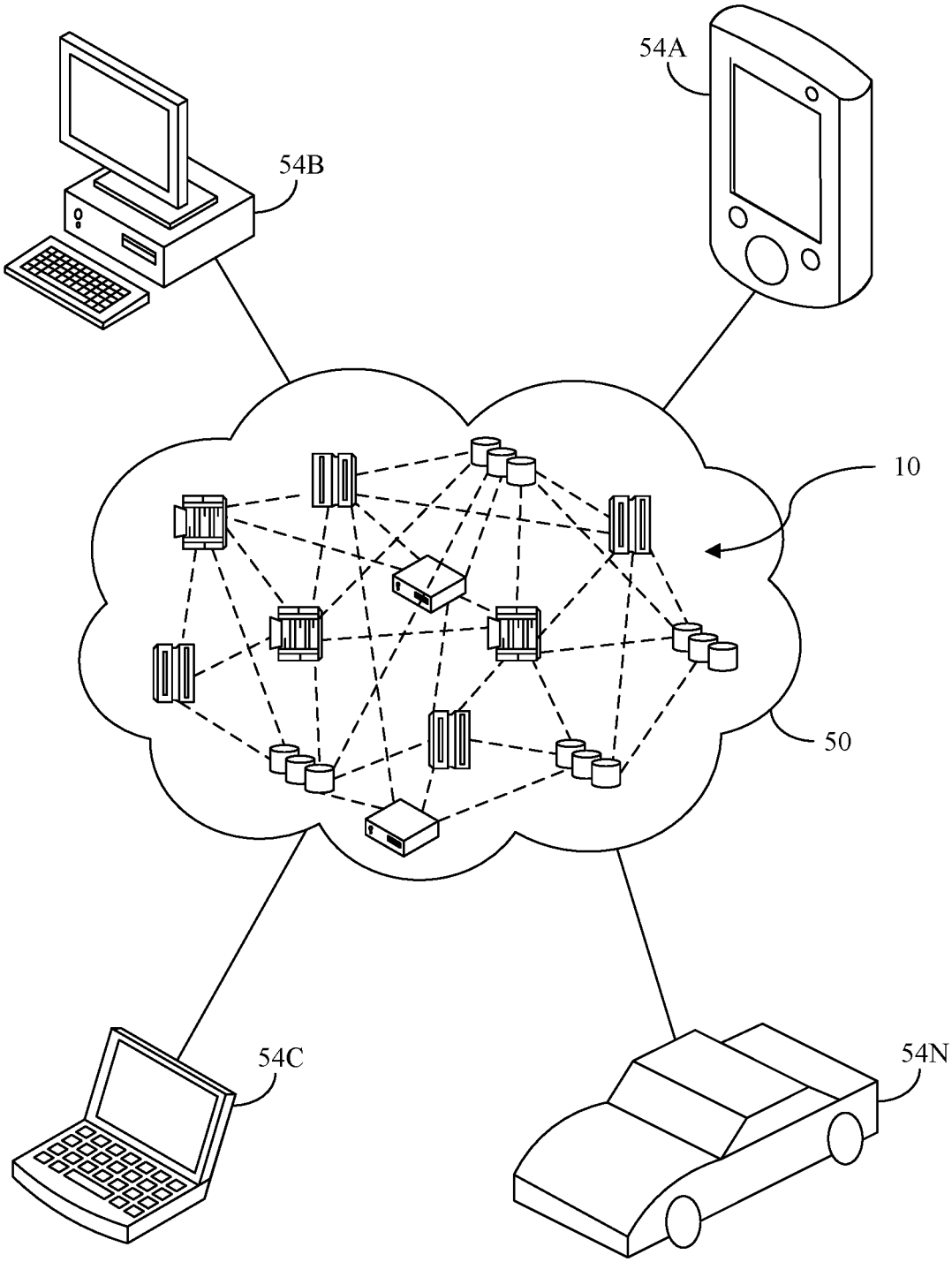
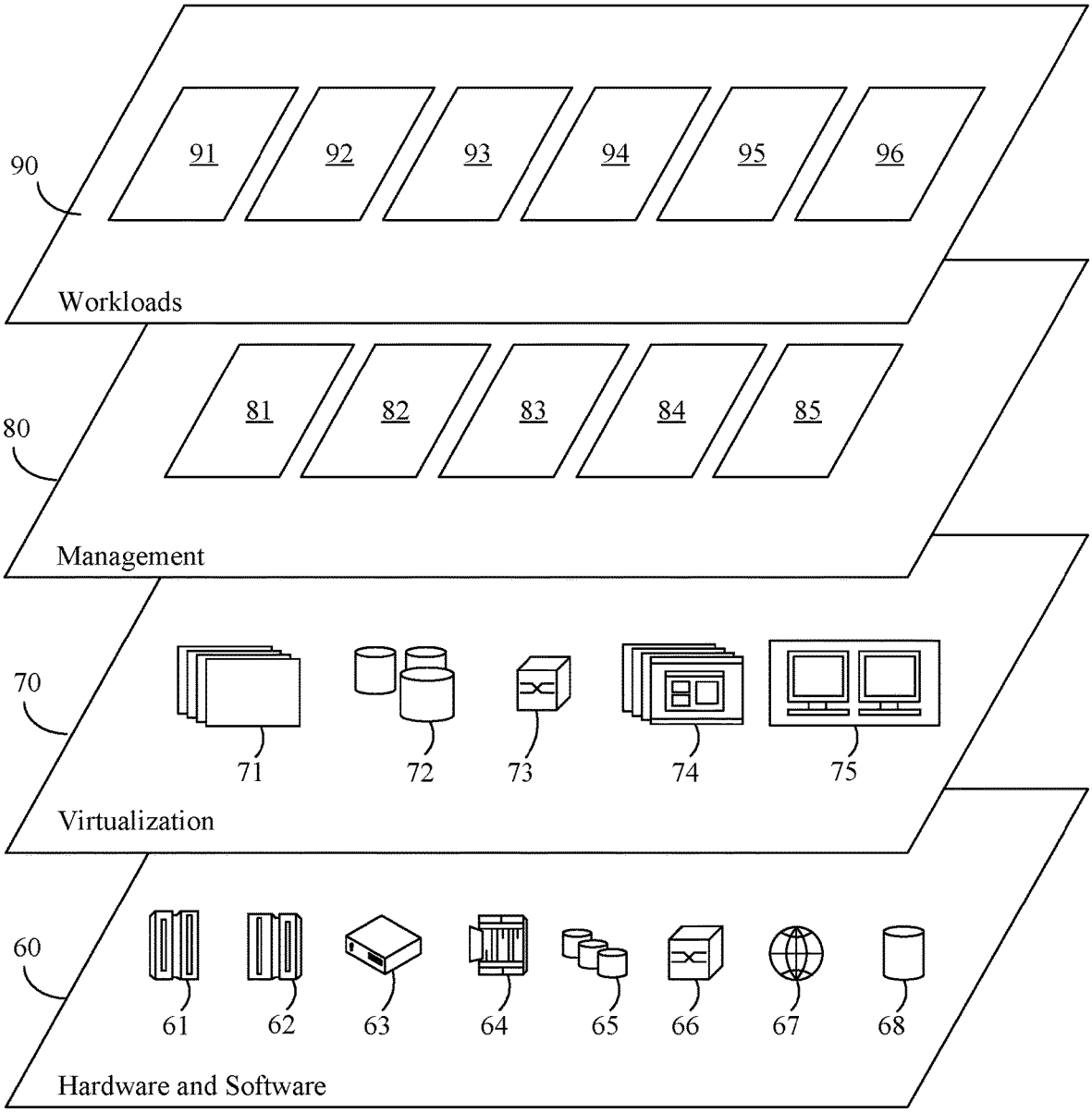


FIG. 1


90
91
92
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94
95
96
Workloads
80
81
82
83
84
85
Management
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71
72
73
74
75
Virtualization
60
61
62
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Hardware and Software

FIG. 2

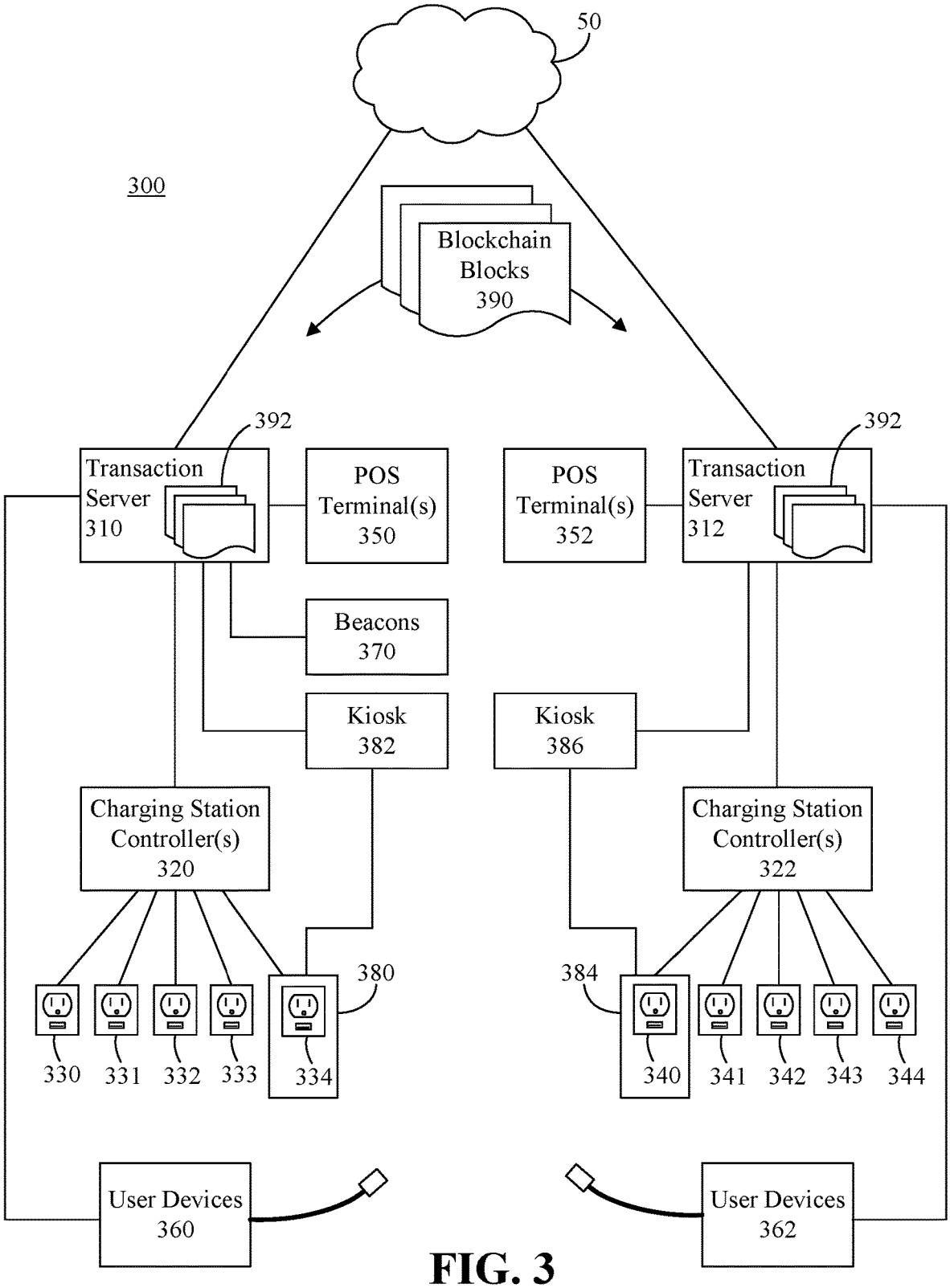

50
300
Blockchain Blocks 390
392
392
Transaction Server 310
POS Terminal(s) 350
POS Terminal(s) 352
Transaction Server 312
Beacons 370
Kiosk 382
Kiosk 386
Charging Station Controller(s) 320
Charging Station Controller(s) 322
380
384
330
331
332
333
334
340
341
342
343
344
User Devices 360
User Devices 362

FIG. 3

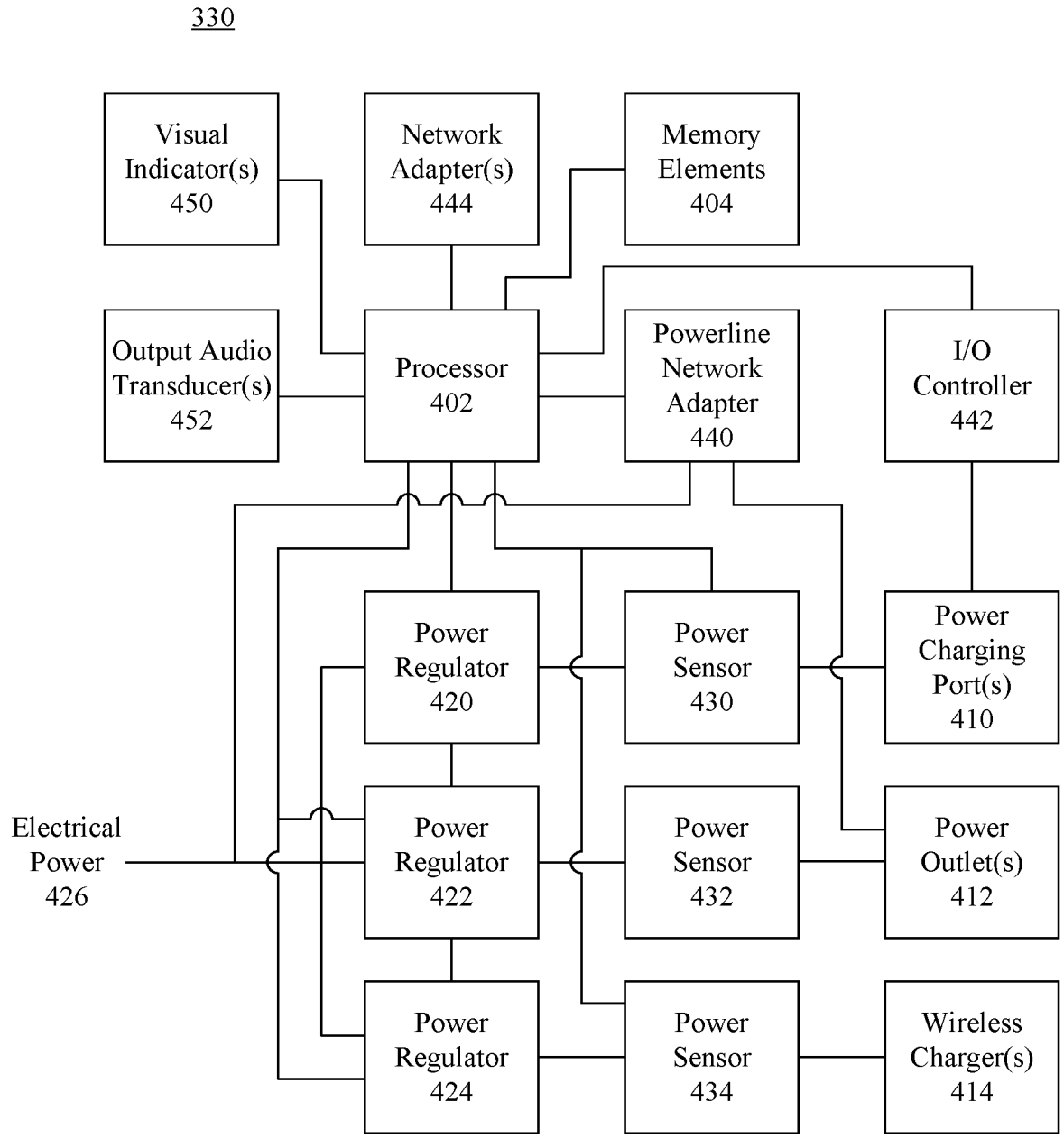
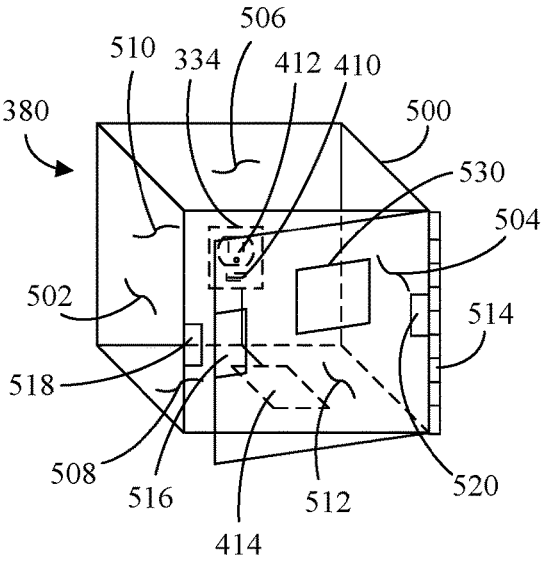

330
Visual Indicator(s) 450
Network Adapter(s) 444
Memory Elements 404
Output Audio Transducer(s) 452
Processor 402
Powerline Network Adapter 440
I/O Controller 442
Power Regulator 420
Power Sensor 430
Power Charging Port(s) 410
Electrical Power 426
Power Regulator 422
Power Sensor 432
Power Outlet(s) 412
Power Regulator 424
Power Sensor 434
Wireless Charger(s) 414

FIG. 4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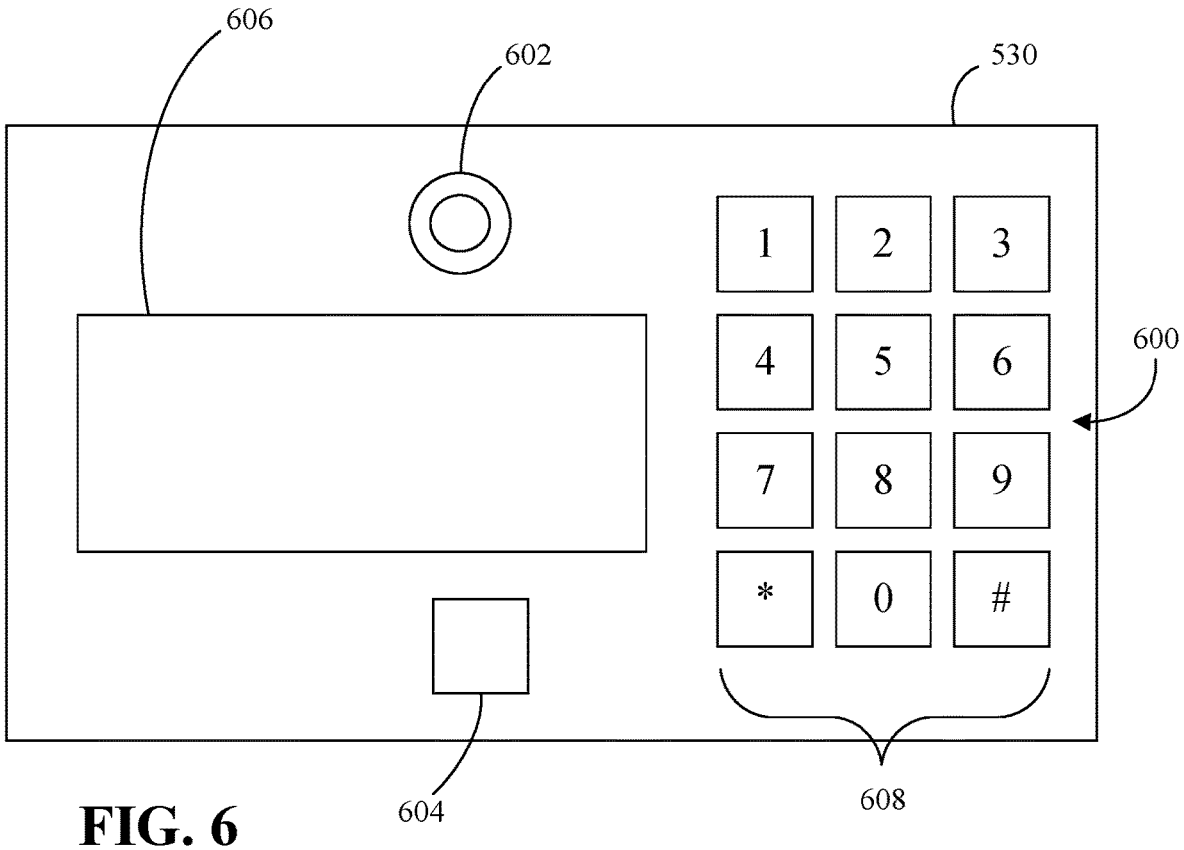
520
414

FIG. 5


606
602
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3
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6
600
7
8
9
*
0
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604
608

FIG. 6

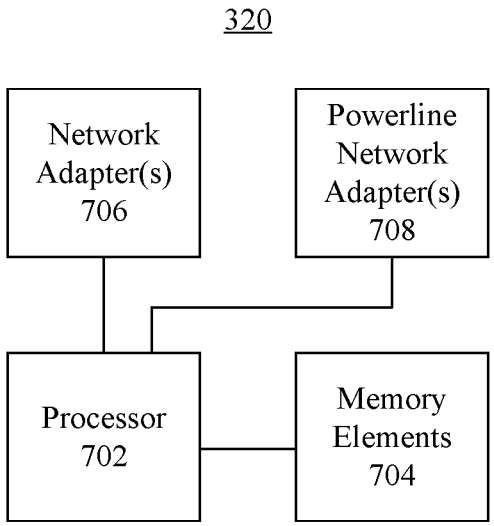
320
Network Adapter(s) 706
Powerline Network Adapter(s) 708
Processor 702
Memory Elements 704

FIG. 7

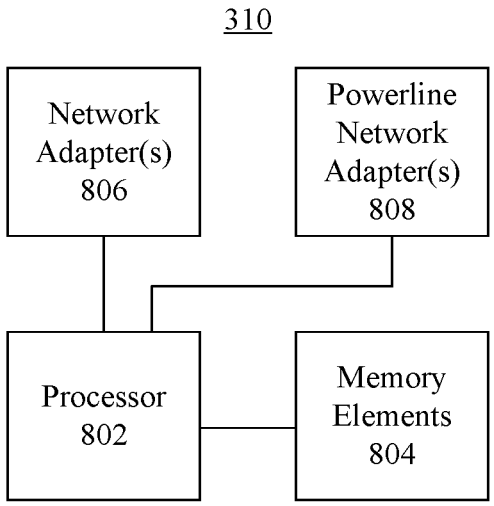
310
Network Adapter(s) 806
Powerline Network Adapter(s) 808
Processor 802
Memory Elements 804

FIG. 8

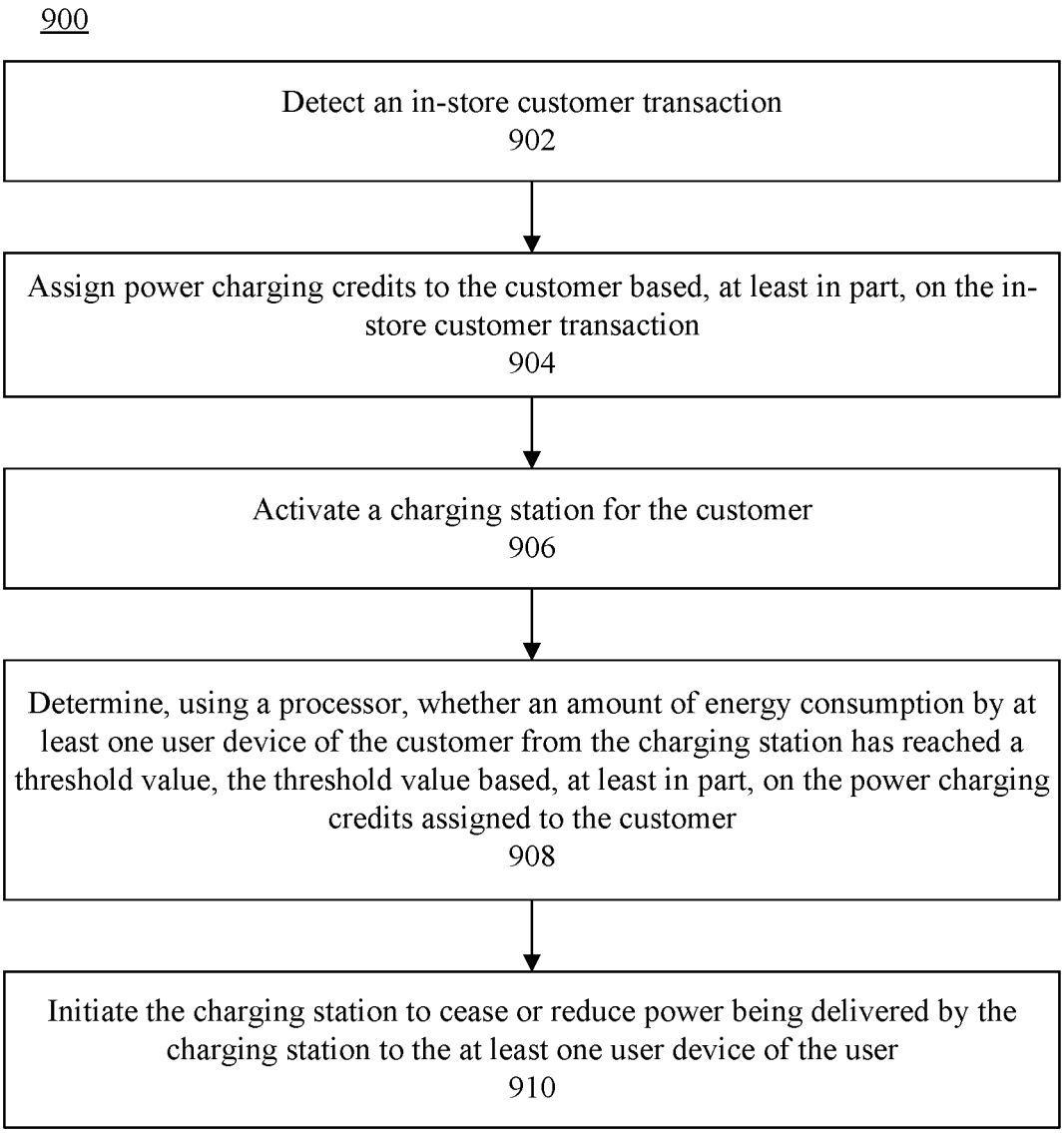
900
Detect an in-store customer transaction
902
Assign power charging credits to the customer based, at least in part, on the in-store customer transaction
904
Activate a charging station for the customer
906
Determine, using a processor, whether an amount of energy consumption by at least one user device of the customer from the charging station has reached a threshold value, the threshold value based, at least in part, on the power charging credits assigned to the customer
908
Initiate the charging station to cease or reduce power being delivered by the charging station to the at least one user device of the user
910

FIG. 9

INTELLIGENT CONTROLLED CHARGING STATIONS

BACKGROUND

The present invention relates to power charging of user devices.

The use of mobile devices, such as smartphones, tablet computers, laptop computers, etc., is commonplace. To support mobility, mobile devices typically include rechargeable batteries used to power the devices. Such batteries store a finite amount of energy and need to be recharged from time to time. To make charging of mobile device batteries more convenient in their facilities, stores, such as cafes, coffee shops, etc., and other facilities oftentimes provide charging outlets and/or charging ports for use by customers to charge their mobile devices.

SUMMARY

A method includes detecting an in-store customer transaction. The method also can include assigning power charging credits to the customer based, at least in part, on the in-store customer transaction. The method also can include activating a charging station for the customer. The method also can include determining, using a processor, whether an amount of energy consumption by at least one user device of the customer from the charging station has reached a threshold value, the threshold value based, at least in part, on the power charging credits assigned to the customer. The method also can include, responsive to determining that the energy consumption by the at least one user device of the customer from the charging station has reached the threshold value, initiating the charging station to cease or reduce power being delivered by the charging station to the at least one user device of the user.

A system includes a processor programmed to initiate executable operations. The executable operations include detecting an in-store customer transaction. The executable operations also can include assigning power charging credits to the customer based, at least in part, on the in-store customer transaction. The executable operations also can include activating a charging station for the customer. The executable operations also can include determining whether an amount of energy consumption by at least one user device of the customer from the charging station has reached a threshold value, the threshold value based, at least in part, on the power charging credits assigned to the customer. The executable operations also can include, responsive to determining that the energy consumption by the at least one user device of the customer from the charging station has reached the threshold value, initiating the charging station to cease or reduce power being delivered by the charging station to the at least one user device of the user.

A computer program product includes a computer readable storage medium having program code stored thereon. The program code is executable by a data processing system to initiate operations. The operations include detecting an in-store customer transaction. The operations also can include assigning power charging credits to the customer based, at least in part, on the in-store customer transaction. The operations also can include activating a charging station for the customer. The operations also can include determining whether an amount of energy consumption by at least one user device of the customer from the charging station has reached a threshold value, the threshold value based, at least in part, on the power charging credits assigned to the customer. The operations also can include, responsive to determining that the energy consumption by the at least one user device of the customer from the charging station has reached the threshold value, initiating the charging station to cease or reduce power being delivered by the charging station to the at least one user device of the user.

This Summary section is provided merely to introduce certain concepts and not to identify any key or essential features of the claimed subject matter. Other features of the inventive arrangements will be apparent from the accompanying drawings and from the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** depicts a cloud computing environment according to an embodiment of the present invention.

FIG. **2** depicts abstraction model layers according to an embodiment of the present invention.

FIG. **3** is a block diagram illustrating example architecture for a power charging system.

FIG. **4** is a block diagram illustrating example architecture for a charging station.

FIG. **5** is a perspective view of an example of a charging locker.

FIG. **6** depicts an example of a user interface of a charging locker.

FIG. **7** is a block diagram illustrating example architecture for a charging station controller.

FIG. **8** is a block diagram illustrating example architecture for a transaction server.

FIG. **9** is a flowchart illustrating an example of a method of providing a power charging service.

DETAILED DESCRIPTION

This disclosure relates to power charging of user devices. In accordance with the inventive arrangements disclosed herein, customers can be assigned power charging credits based on in-store purchases. The customers can use the power charging credits to charge their user devices at charging stations. Power charging credits can be detected from the customer's power charging credits based on an amount of energy consumed by the customer's user devices and/or an amount of time the user devices are charged. The power charging credits can be assigned, deducted, and transferred using a distributed ledger, such as a blockchain. Numerous arrangements related to assignment, use and deduction of power charging credits are described herein.

Several definitions that apply throughout this document now will be presented.

As defined herein, the term "store" means a physical place where a customer may purchase goods and/or services.

As defined herein, the term "in-store transaction" means a purchase transaction made at a store for a customer.

As defined herein, the term "customer" means a person (i.e., a human being).

As defined herein, the term "user" means a person.

As defined herein the term "user device" means a portable rechargeable device used by a person. Examples of a user device include a smart phone, a portable computer (e.g., a laptop computer, a tablet computer, etc.), a smart watch, smart glasses, a rechargeable mouse, a rechargeable keyboard, rechargeable headphones, and a portable rechargeable power supply.

As defined herein, the term "charging station" means a power charging device including at least one power outlet, at least one power charging port and/or at least one wireless

charger, the power charging device configured to be operable between an activated state in which the power charging device provides power to the at least one power outlet, at least one power charging port and/or at least one wireless charger, and a deactivated state where the power charging device does not provide power to the at least one power outlet, at least one power charging port and/or at least one wireless charger.

As defined herein, the term "charging station" means an apparatus including at least one power charging port, power outlet and/or wireless charger used for charging user devices.

As defined herein, the term "energy consumption" means an amount of energy consumed by at least one user device to operate and/or charge at least one battery while the user device is charging. Energy consumption typically is measured in kilowatt-hours (kWh), but also may be measured in joules (J). As the term "energy consumption" is defined herein, an amount of time a user device is charged is not energy consumption. For example, assume a first user device and a second user device both are charged for the same amount of time at the same voltage. If the first user device draws more current than the second user device while they are charging, the first user device will have higher energy consumption than the second user device, even though the devices are charged for the same amount of time.

As defined herein the term "power" means an amount of energy transferred per unit of time. Power typically is measured in watts (W).

As defined herein, the term "distributed ledger" means a consensus of replicated, shared, and synchronized digital data, having no central administration, geographically spread across multiple sites, countries, and/or institutions. As the term "distributed ledger" is defined herein, a distributed database is not a distributed ledger. In this regard, a distributed database has central administration.

As defined herein, the term "blockchain" means a form of distributed ledger comprising a growing list of records, called blocks, that are linked using cryptography.

As defined herein, the term "responsive to" means responding or reacting readily to an action or event. Thus, if a second action is performed "responsive to" a first action, there is a causal relationship between an occurrence of the first action and an occurrence of the second action, and the term "responsive to" indicates such causal relationship.

As defined herein, the term "computer readable storage medium" means a storage medium that contains or stores program code for use by or in connection with an instruction execution system, apparatus, or device. As defined herein, a "computer readable storage medium" is not a transitory, propagating signal per se.

As defined herein, the term "data processing system" means one or more hardware systems configured to process data, each hardware system including at least one processor programmed to initiate executable operations and memory.

As defined herein, the term "processor" means at least one hardware circuit (e.g., an integrated circuit) configured to carry out instructions contained in program code. Examples of a processor include, but are not limited to, a central processing unit (CPU), an array processor, a vector processor, a digital signal processor (DSP), a field-programmable gate array (FPGA), a programmable logic array (PLA), an application specific integrated circuit (ASIC), programmable logic circuitry, and a controller.

As defined herein, the term "server" means a data processing system configured to share services with one or more other data processing systems.

As defined herein, the term "automatically" means without user intervention.

It is to be understood that although this disclosure includes a detailed description on cloud computing, implementation of the teachings recited herein are not limited to a cloud computing environment. Rather, embodiments of the present invention are capable of being implemented in conjunction with any other type of computing environment now known or later developed.

Cloud computing is a model of service delivery for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, network bandwidth, servers, processing, memory, storage, applications, virtual machines, and services) that can be rapidly provisioned and released with minimal management effort or interaction with a provider of the service. This cloud model may include at least five characteristics, at least three service models, and at least four deployment models.

Characteristics are as follows:

On-demand self-service: a cloud consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with the service's provider.

Broad network access: capabilities are available over a network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, laptops, and PDAs).

Resource pooling: the provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to demand. There is a sense of location independence in that the consumer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter).

Rapid elasticity: capabilities can be rapidly and elastically provisioned, in some cases automatically, to quickly scale out and rapidly released to quickly scale in. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be purchased in any quantity at any time.

Measured service: cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service.

Service Models are as follows:

Software as a Service (SaaS): the capability provided to the consumer is to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices through a thin client interface such as a web browser (e.g., web-based e-mail). The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings.

Platform as a Service (PaaS): the capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages and tools supported by the provider. The consumer does not manage or control the underlying cloud infrastructure including networks, servers, operating

systems, or storage, but has control over the deployed applications and possibly application hosting environment configurations.

Infrastructure as a Service (IaaS): the capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, deployed applications, and possibly limited control of select networking components (e.g., host firewalls).

Deployment Models are as follows:

Private cloud: the cloud infrastructure is operated solely for an organization. It may be managed by the organization or a third party and may exist on-premises or off-premises.

Community cloud: the cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns (e.g., mission, security requirements policy, and compliance considerations). It may be managed by the organizations or a third party and may exist on-premises or off-premises.

Public cloud: the cloud infrastructure is made available to the general public or a large industry group and is owned by an organization selling cloud services.

Hybrid cloud: the cloud infrastructure is a composition of two or more clouds (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load-balancing between clouds).

A cloud computing environment is service oriented with a focus on statelessness, low coupling, modularity, and semantic interoperability. At the heart of cloud computing is an infrastructure that includes a network of interconnected nodes.

Referring now to FIG. **1**, illustrative cloud computing environment **50** is depicted. As shown, cloud computing environment **50** includes one or more cloud computing nodes **10** with which local computing devices used by cloud consumers, such as, for example, personal digital assistant (PDA) or cellular telephone **54**A, desktop computer **54**B, laptop computer **54**C, and/or automobile computer system **54**N may communicate. Nodes **10** may communicate with one another. They may be grouped (not shown) physically or virtually, in one or more networks, such as Private, Community, Public, or Hybrid clouds as described hereinabove, or a combination thereof. This allows cloud computing environment **50** to offer infrastructure, platforms and/or software as services for which a cloud consumer does not need to maintain resources on a local computing device. It is understood that the types of computing devices **54**A-N shown in FIG. **1** are intended to be illustrative only and that computing nodes **10** and cloud computing environment **50** can communicate with any type of computerized device over any type of network and/or network addressable connection (e.g., using a web browser).

Referring now to FIG. **2**, a set of functional abstraction layers provided by cloud computing environment **50** (FIG. **1**) is shown. It should be understood in advance that the components, layers, and functions shown in FIG. **2** are intended to be illustrative only and embodiments of the invention are not limited thereto. As depicted, the following layers and corresponding functions are provided:

Hardware and software layer **60** includes hardware and software components. Examples of hardware components include: mainframes **61**; RISC (Reduced Instruction Set Computer) architecture based servers **62**; servers **63**; blade servers **64**; storage devices **65**; and networks and networking components **66**. In some embodiments, software components include network application server software **67** and database software **68**.

Virtualization layer **70** provides an abstraction layer from which the following examples of virtual entities may be provided: virtual servers **71**; virtual storage **72**; virtual networks **73**, including virtual private networks; virtual applications and operating systems **74**; and virtual clients **75**.

In an example, management layer **80** may provide the functions described below. Resource provisioning **81** provides dynamic procurement of computing resources and other resources that are utilized to perform tasks within the cloud computing environment. Metering and Pricing **82** provide cost tracking as resources are utilized within the cloud computing environment, and billing or invoicing for consumption of these resources. In one example, these resources may include application software licenses. Security provides identity verification for cloud consumers and tasks, as well as protection for data and other resources. User portal **83** provides access to the cloud computing environment for consumers and system administrators. Service level management **84** provides cloud computing resource allocation and management such that required service levels are met. Service Level Agreement (SLA) planning and fulfillment **85** provide pre-arrangement for, and procurement of, cloud computing resources for which a future requirement is anticipated in accordance with an SLA.

Workloads layer **90** provides examples of functionality for which the cloud computing environment may be utilized. Examples of workloads and functions which may be provided from this layer include: mapping and navigation **91**; software development and lifecycle management **92**; virtual classroom education delivery **93**; data analytics processing **94**; transaction processing **95**; and user experience **96**.

FIG. **3** is a block diagram illustrating example architecture for a power charging system **300**. The power charging system **300** can include a plurality of transaction servers **310**, **312** communicatively linked to the cloud computing environment **50**, for example via the Internet. The transaction servers **310**, **312** can be implemented as data processing systems. The transaction server **310** can be communicatively linked to one or more charging station controllers **320**. The transaction server **312** can be communicatively linked to one or more charging station controllers **322** in a similar manner. The charging station controller(s) **320** can be communicatively linked to a plurality of charging stations **330**, **331**, **332**, **333**, **334**, and the charging station controller(s) **322** can be communicatively linked to a plurality of charging stations **340**, **341**, **342**, **343**, **344**. Further, the transaction server **310** can be communicatively linked to one or more Point of Sale (POS) terminals **350** (e.g., electronic cash registers, electronic payment terminals, etc.), and the transaction server **312** can be communicatively linked to one or more Point of Sale (POS) terminals **352**. User devices **360**, **362** can interface with the transaction servers **310**, **312**, for example using mobile applications and/or web browsers accessing web-based applications, to gain access to the charging stations **330-334**, **340-344**, as will be described herein.

Each communication link between the transaction servers **310**, **312** and the charging station controllers **320**, **322**, between the transaction servers **310**, **312** and the POS terminals **350**, **352** and between the transaction servers **310**, **312** and the user devices **360**, **362** can be implemented, for example, using a personal area network (PAN), a local area

network (LAN), a wide area network (WAN), a Virtual Private Network (VPN), the Internet, the Public Switched Telephone Network (PSTN), and/or similar technologies. A PAN can be implemented, for instance, using Bluetooth®, Bluetooth® Low Energy (BTE), Wireless Universal Serial Bus (USB), ZigBee® or Infrared Data Association (IrDA). Each communication link between the charging station controllers **320**, **322** and the charging stations **330-344**, **340-344** can be implemented, for example, using a PAN, a LAN, a WAN, a VPN, the Internet, the PSTN, and/or similar technologies. In some arrangements, the charging station controllers **320**, **322** and the charging stations **330-334**, **340-344**, can be configured to communicate over the electrical power wiring between the charging station controllers **320**, **322** and the charging stations **330-334**, **340-344** using powerline communication. For example, the charging station controllers **320**, **322** and the charging stations **330-345** each can include, or otherwise be communicatively coupled to, a powerline network adapter.

In a non-limiting arrangement, the charging station controllers **320**, **322** can components of the transaction servers **310**, **312** or co-located with the transaction servers **310**, **312**. In such an arrangement, external communication links between the transaction servers **310**, **312** and the charging station controllers **320**, **322** need not be established. Instead, the charging stations **330-334** can establish communication links with the transaction server **310** and the charging stations **340-344** can establish communication links with the transaction server **312**. For example, communication links between the transaction servers **310**, **312** and the charging stations **330-334**, **340-344** can be implemented, for example, using PANs, LANs, WANs, VPNs, the Internet, the PSTN, and/or similar technologies.

By way of example, a transaction server **310** can be configured to monitor purchase transactions made via one or more POS terminals **350** for a particular facility (e.g., business location). Similarly, a transaction server **312** can be configured to monitor purchase transactions made via one or more POS terminals **352** for another particular facility. In an example, a business may maintain a transaction server **310** at each of a plurality of facilities, in which case a transaction server **310** can communicate with one or more charging station controller(s) **320** and one or more POS terminals **350** located at the same facility. In another example, a business may maintain one or more centrally located transaction servers **310** with which charging station controllers **320** and POS terminals **350** deployed at a plurality of facilities communicate. If the charging station controller **320** is a component of the transaction server **310** or co-located with the transaction server **310**, the transaction server **310** can communicate with the charging stations **330-334** and the POS terminals **350**, regardless whether the transaction server **310** is remotely located or located at a facility where the POS terminals **350** and charging stations **330-334** reside.

In operation, a customer can initiate an in-store transaction, such as a purchase transaction at a facility, such as a coffee shop, cafe, restaurant, arena, movie theater, mall, etc. In an arrangement, the customer can pay for the transaction using a user device **360**, such as a smart phone, tablet computer, smart watch, smart glasses, or the like. For example, the customer can launch a mobile application that presents a barcode, quick response (QR) code, or the like which is scanned at the POS terminal **350** to make payment for the in-store transaction. In response, the POS terminal **350**, or the transaction server **310** based in data received from the POS terminal **350**, can determine from the bar code, QR code, etc. a user ID (user ID) assigned to the customer and create a data record in a database indicating a purchase amount of the in-store transaction. In another example, the customer can pay for the in-store transaction with the user device **360** using a near field communication (NFC) payment. In response, the POS terminal **350**, or the transaction server **310** based in data received from the POS terminal **350**, can determine from data transferred during the NFC payment the user ID assigned to the customer and create a data record in a database indicating a purchase amount of the in-store transaction. In another example, the customer can pay for the in-store transaction using cash, credit card or debit card. If using cash, credit card or debit card, the customer can provide to a store clerk a user ID, which the store clerk can enter into the POS terminal **305**, or the customer enter the user ID via a touchscreen or keypad of the POS terminal **350**. In response, the POS terminal **350**, or the transaction server **310**, can create a data record in a database indicating a purchase amount of the in-store transaction for that user ID. Still, the purchase amount and user ID can be determined and stored to a computer-readable storage medium in any suitable manner, and the present arrangements are not limited in this regard.

In one or more arrangements, the user ID can be stored in a user profile for the customer accessible by the transaction servers **310**, **312**. For example, the user profile can be stored to one or more computer readable storage mediums in the cloud computing environment **50**, such as in a database managed by one or more servers. The customer's user profile also can include, for example, one or more passwords, one or more passcodes, a listing of user devices used by the customer, instant messaging address (e.g., telephone number), e-mail address, etc. The listing of user devices can include, for example, a device identifier assigned to each of the customer's user devices, for example a media access control (MAC) address of each of the customer's user devices, a name assigned to each of the customer's user devices, a make and model of each of the customer's user devices, user device configurations (e.g., type of processor, type of GPU, amount of RAM, amount of data storage, type of data storage, and so on), etc. The customer can create and update the customer's user profile via the user portal **83** (FIG. **1**) using a mobile application or web browser on a user device to connect to a user experience **96** (FIG. **1**) application in the cloud computing environment **50**. In illustration, each time the customer accesses the user experience **96** application, the mobile application or web browser can communicate to the user experience **96** the identifier of the user device **360** being used to connect to the user experience **96** application. The user experience **96** application can determine whether that user device **360** is already listed in the customer's user profile. If not, via the mobile application or web browser, the user experience **96** application can prompt the customer to choose whether to associate that particular user device **360** with the customer. If the customer chooses in the affirmative, the user experience **96** application can add that user device **360** to the customer's listing of user devices.

Based on the in-store transaction, the transaction server **310** can assign to the customer, for example to the customer's user ID, power charging credits. For example, the transaction server **310** can assign power charging credits based on the purchase amount, a frequency of purchases made by the customer with that store and/or an enterprise associated with the store, a promotion applied for the user purchasing one or more certain items, and so on. The customer may use the power charging credits to charge one or more of the customer's user devices **360** using one or

more of the charging stations **330-334**, **340-344** at the facility and other facilities. The power charging credits may be assigned to the customer's user profile and/or the customer's user account with the establishment. Via a mobile application, or web browser, a customer may access his/her user profile to view their available power charging credits, their power charging credit usage information, energy consumption quotas (e.g., an amount of time or energy consumption available to the user for the current day), and other user profile information. A customer also may transfer at least a portion of their power charging credits to one or more other users.

In illustration, responsive to the customer's in-store transaction, using the customer's user ID the transaction server **310** can access the customer's user profile and obtain the listing of identifiers for the customer's user devices **360**. Using those identifiers, the transaction server **310** can monitor a network (e.g., a LAN or PAN) of the store to identify a connection to the network by one or more of the customer's user devices **360**. Further, the transaction server **310** can track the physical location and movement of the customer's user devices **360** in the facility, for example using beacons **370** or another suitable indoor positioning system. By way of example, the network can include a plurality of beacons **370** that detect WiFi® communication signals generated by user devices **360** and determine physical location and movement within the store using triangulation, trilateration, or the like. In another example, the network can include an indoor positioning system that detect PAN communication signals generated by user devices **360** and determine physical location and movement within the store using triangulation, trilateration, or the like.

Tracking the physical location and movement of the customer's user devices **360** in the facility, the transaction server **310** can track a path of the customer with respect to locations of a plurality of charging stations **330-334** at the facility. Further, the transaction server **310** can determine whether the customer stops or pauses near at least one charging station **330-334** for at least a threshold period of time (e.g., at least three seconds, five seconds, ten seconds, etc.) that is presently available for use (i.e., not currently being used to charge other user devices). In this regard, the transaction server **310** can store, or otherwise access, data indicating the physical location of each of the charging stations **330-334** within the facility and compare the customer's physical location to that data. Further, the transaction server **310** can query the charging station controller **320** to determine which charging stations **330-334** are currently available. The transaction server **310** can select from among the charging stations **330-334** that currently are available the charging station **330** that is physically located nearest to the customer's physical location and activate the selected charging station **330** to provide power via one or more power outlets, one or more power charging ports and/or one or more wireless chargers.

The transaction server **310** can activate the charging station **330** by communicating to the charging station controller **320** a command to activate the charging station **330**. In response, the charging station controller **320** can communicate a command to the charging station **330** to activate. In response, the charging station **330** can turn on power to the one or more power outlets, one or more power charging ports, and/or one or more wireless chargers, for example using one or more relays or other components suitable for this purpose. In this regard, activation of the charging station **330** can configure the charging station **330** to turn on one or more power outlets, one or more charging ports and/or one or more wireless chargers. The transaction server **310** can activate the charging stations **331-334** in a similar manner.

In an arrangement in which electrical wiring providing power to the charging station **330** for charging user devices **360** is connected to the charging station controller **320**, responsive to receiving an activation command from the transaction server **310** to activate the charging station **330**, the charging station controller **320** can activate the charging station **330** by turning on power to the electrical wiring, for example using a relay. Turning on the power to the electrical wiring can turn on power to the one or more power outlets, one or more power charging ports, and/or one or more wireless chargers. In an arrangement in which the charging station **330** does not include an additional power source to provide power to one or more other components of the power charging station **330** (e.g., processors, sensors, image capture devices, etc.), turning on the power to the electrical wiring can turn on those other components. The transaction server **310** can activate the charging stations **331-334** in a similar manner.

In one or more arrangements, the transaction server **310** can alert the customer as to which charging station **330** is assigned to the customer. For example, each of the charging stations can be labeled with a charging station identifier (e.g., one or more numbers, letters and/or symbols), and the transaction server **310** can communicate the charging station identifier to a mobile application, or web browser executing on the user device **360** accessing a web-based application to which the transaction server **310** has elevated access, an instant messaging address of the customer, or an e-mail address of the customer. The instant message address and e-mail address can be indicated in the customer's user profile. In another example, each charging station **330-334** can include at least one visible indicator, for example one or more lights (e.g., LEDs). The transaction server **310** can communicate to the charging station controller **320** a command to activate the visible indicator on the selected charging station **330** (e.g., illuminate one or more LEDs). In response, the charging station controller **320** can communicate a command to the charging station **330** causing the charging station **330** to activate the visible indicator. The charging station controller **320** and/or the charging station **330** can be configured to keep the visible indicator active until the charging station **330** detects power draw from the charging station **330**, which indicates a user device **360** has been coupled to the charging station **330** for charging, and/or keep the visible indicator active for a threshold period of time.

In some instances, there may not be any charging stations **330-334** that are currently available. In response to detecting such circumstance, the transaction server **310** can add the customer to a waiting list and communicate an alert to the customer's user device indicating that the customer has been added to a waiting list and will be alerted when a charging station **330-334** becomes available. The transaction server **310** can monitor the charging stations **330-334** to determine when a charging station becomes available. In illustration, the transaction can determine when a charging station **330** no longer is being used to charge user devices **360** and there is no longer a customer within a threshold distance of the charging station **330**. In response, the transaction server **310** can select a customer at the top of the waiting list and communicate an alert to that customer indicating a charging station currently is available for that customer. The transaction server also can indicate to the customer where the charging station **330** is located, for example as previously described.

In one or more arrangements, one or more of the customer's user devices **360** can communicate to the charging station **330** the user ID of the customer. For example, responsive to a user device **360** being coupled to a charging port (e.g., USB port, Lightening port, etc.) of the charging station **310**, via the charging port the user device **360** can communicate to the charging station **310** the device identifier assigned to the user device **360**. In response, the charging station **330** can communicate that device identifier to the charging station controller **320**. In response, the charging station controller **320** can communicate that device identifier to the transaction server **310**. The transaction server **310** can query the database of user profiles to determine the user ID of the customer to whom the user device **360** is assigned.

In another example, in lieu of, or in addition to, communicating the device identifier, the user device **360** can communicate the user ID for the customer to the charging station **330**, which can communicate that user ID to the transaction server **310**. For example, a mobile application on the user device **360**, or a web browser on the user device **360** accessing a web-based application, can communicate the user ID to the charging station **330**. In response, the charging station **330** can communicate that user ID to the charging station controller **320**. In response, the charging station controller **320** can communicate that user ID to the transaction server **310**.

In some examples, the user device **360** can communicate the device identifier and/or user ID to the charging station **330** via a PAN. For instance, if the user device **360** has Bluetooth® enabled, the customer can pair the user device **360** with the charging station **330** and communicate the device identifier and/or user ID to the charging station **330** via Bluetooth® or BTE. Regardless of the method used to communicate the device identifier and/or user ID, the charging station **330** can communicate the device identifier and/or user ID to the charging station controller **320**. In response, the charging station controller **320** can communicate the device identifier and/or user ID to the transaction server **310**.

In some examples, the user device **360** can communicate the device identifier and/or user ID to the charging station **330** via the power outlet in an arrangement in which the charging station **330** is configured to receive data via the power outlet, for example using a powerline communication. In illustration, the user device **360** can be configured to communicate data using powerline communication. For instance, the user device **360** can include, or otherwise be coupled to, a powerline network adapter, and the charging station **330** can include a powerline network adapter. In an arrangement in which the user device **360** is coupled to an external powerline network adapter, the user device **360** can couple to the external powerline network adapter using an ethernet cable, using WiFi®, using a PAN, etc.

Responsive to the charging station **330** detecting power draw from the charging station **330** commencing, the charging station **330** can communicate to the charging station controller **320** an indicator indicating that the charging station **330** is in use. In response, the charging station controller **320** can communicate an indicator to the transaction server **310** indicating that the charging station **330** is in use. In response, the transaction server **310** can begin timing the amount of time the customer uses the charging station **330**. Responsive to the charging station **330** detecting power draw from the charging station **330** ceasing, the charging station **330** can communicate to the charging station controller **320** an indicator indicating that the power draw from the charging station **330** has ceased. In response, the charging station controller **320** can communicate an indicator to the transaction server **310** indicating that the power draw from the charging station **330** has ceased. In response, the transaction server **310** can stop timing the amount of time the customer uses the charging station **330**. In this regard, the transaction server **310** can monitor and determine the amount of time various customers use various charging stations **330-334**.

In addition to, or in lieu of, tracking the amount of time customers use the charging stations **330-334**, the transaction server **310** also can monitor and determine the amount of power consumed by the customers user devices **360**. In illustration, one or more of the charging stations **330-334** can include a power sensor that measures power consumption. While the customer uses the charging station **330**, the charging station **330** can monitor data generated by the power sensor to determine a running total of energy consumption by the customer's user devices **360**. The charging station **330** can communicate the running total of energy consumption to the charging station controller **320**, which can communicate the running total of energy consumption to the transaction server. In this regard, the transaction server **310** can determine the energy consumption by various customers using various charging stations **330-334**.

In another example, the transaction server **310** can store, other otherwise access, one or more data tables including records that indicate a level of energy consumption (e.g., an average level of energy consumption) for numerous different models of user devices **360**. The data tables also may provide further granularity, for example indicating a level of energy consumption for particular configurations of various different models of user devices **360**. The transaction server **310** can determine the amount of energy consumption for user devices **360** based on their level of energy consumption and the amount of time they are coupled to the charging stations **330-334**. In illustration, responsive to being coupled to the charging station **330**, the user devices **360** can communicate to the transaction server **310**, either directly or via the charging station **330** and charging station controller **320**, its MAC addresses and/or make and model information. If the user device **360** communicates its MAC address, the transaction server **310** can determine the make and model of the user device **360** using the customer's user profile, which may list the MAC address of each of the customer's user devices **360**, or in any other suitable manner. The transaction server **310** can determine the energy consumption total by, for each of the customer's user devices **360** coupled to the charging station **330**, multiplying the amount of time the user device **360** is coupled to the charging station **330** and the level of energy consumption indicated for that user device **360**. Further, the transaction server **310** also can monitor a running total of the energy consumption by the user devices **360** based on the amount of time the user devices **360** are being charged and their levels of energy consumption.

The transaction server **310** can continue to monitor the physical location of the customer in the facility. Responsive to detecting the customer moving away from the charging station **330** by at least a threshold distance, or responsive to detecting the customer leaving the facility, after power draw from the charging station **330** has ceased, the transaction server **310** can deactivate the charging station **330** by communicating to the charging station controller **320** a command to deactivate the charging station **330**. In response, the charging station controller **320** can communicate a command to the charging station **330** to deactivate. Deactivation of the charging station **330** configures the charging station **330** to turn off one or more power outlets,

one or more charging ports and/or one or more wireless chargers. The transaction server **310** can deactivate the charging stations **331-334** in a similar manner.

In an arrangement in which electrical wiring providing power to the charging station **330** for charging user devices **360** is connected to the charging station controller **320**, responsive to receiving a deactivation command from the transaction server **310** to deactivate the charging station **330**, the charging station controller **320** can deactivate the charging station **330** by turning off power to the electrical wiring, for example using a relay. Turning off the power to the electrical wiring can turn off power to the one or more power outlets, one or more power charging ports, and/or one or more wireless chargers. In an arrangement in which the charging station **330** does not include an additional power source to provide power to one or more other components of the power charging station **330** (e.g., processors, sensors, image capture devices, etc.), turning off the power to the electrical wiring can turn off those other components. The transaction server **310** can deactivate the charging stations **331-334** in a similar manner.

Further, the transaction server **310** can deduct from the customer's power charging credits a number of power charging credits determine based on the amount of time the customer used the charging station **330** to charge the user device(s) **360**, the amount of power provided by the charging station **330** to charge the user device(s) **360** and/or the number of user device(s) to which the charging station **330** provided power. In an example, the transaction server **310** can deduct power charging credits in real time as the customer continues to use the charging station **330**, for example at a certain rate based on time, energy consumption and/or number of user devices **360** being charged. In another example, the transaction server **310** can deduct power charging credits responsive to the charging station **330** being deactivated.

In one or more arrangements, the transaction server **310** can continually monitor the amount of time customers use charging stations **330-334** and/or the amount of energy consumption used by customers' user devices **360**, and implement actions based on the amount of time and/or energy consumption. For example, responsive to the amount of time the customer uses the charging station **330** exceeding one or more time threshold values and/or responsive to the amount of energy consumption by the customer's user device(s) **160** exceeding one or more power threshold values, the transaction server **310** can implement one or more actions.

In illustration, the transaction server **310** can determine a first time threshold value based on the amount of power charging credits assigned to the customer's user profile and/or the customer's user account. In one or more examples, each power charging credit can equate to a particular duration of time, and the first time threshold can be determined by multiplying the number of power charging credits by the particular duration of time (e.g., CC×T, where CC=the number of charging credits and T=the particular duration of time). In one or more examples, the first time threshold can be determined by multiplying the number of power charging credits by the particular duration of time and dividing by the number of the customer's user devices **360** being charged (e.g., (CC×T)/N, where CC=the number charging credits, T=the particular duration of time and N=the number of user devices being charged). The transaction server **310** can determine a second time threshold value based on the first time threshold. For example, the second time threshold can be a time that is fifteen minutes prior to the first time threshold.

Similarly, the transaction server **310** can determine a first energy consumption threshold value based on the amount of power charging credits assigned to the customer's user profile and/or the customer's user account. For instance, each power charging credit can equate to a particular amount of energy consumption, and the first energy consumption threshold can be determined by multiplying the number of power charging credits by the particular amount of energy consumption (e.g., CC×P, where CC=the charging credits and P=the amount of energy consumption). The transaction server **310** can determine a second energy consumption threshold value based on the first energy consumption threshold. For example, the second energy consumption threshold can be an energy consumption that is eighty-five percent of the first energy consumption threshold value.

Responsive to the transaction server **310** determining the amount of time the customer has used the charging station **330** exceeding the second time threshold value and/or responsive to the transaction server **310** determining the energy consumption by the customer's user device(s) **360** from the charging station **330** exceeding the second energy consumption threshold value, the transaction server **310** can generate an alert for presentation to the customer indicating that the amount of available time and/or available energy consumption remaining for that customer is low. By way of example, the transaction server **310** can communicate an alert to a mobile application or web-based application open by the user device **360**, and the mobile application or web-based application can present the alert to the user. For instance, the transaction server **310** can communicate the alert to the charge station controller **320**, which can communicate the alert to the charging station **330**. The charging station **330** can communicate the alert to the user device **360** via the charging port, power outlet and/or PAN previously described. In another example, for example in an arrangement in which a user device **360** is coupled to a network (e.g., a WiFi® network) of the facility, the transaction server **310** can communicate the alert to the mobile application or web-based application via the network. In yet another example, the transaction server **310** can communicate the alert to the customer's instant messaging address or e-mail address.

Responsive to the transaction server **310** determining the amount of time the customer has used the charging station **330** exceeding the first time threshold value and/or responsive to the transaction server **310** determining the energy consumption by the customer's user device(s) from the charging station **330** exceeding the first energy consumption threshold value, the transaction server **310** can generate another alert for presentation to the customer indicating that the amount of available time and/or available energy consumption remaining for that customer has been reached. Further, the transaction server **310** can automatically deactivate the charging station **330** immediately or after a predetermined threshold of time, for example five minutes, thus ceasing delivery of power from the charging station **330**. In another example, the transaction server **310** can cause the charging station **330** to reduce the amount of power being provided by the charging station **330** to operate and/or charge the customer's user device(s) **360**. For instance, the transaction server **310** can communicate to the charging station controller **320** a command to reduce the amount of current being delivered to the charging station **330**. In an arrangement in which power delivered to the charging

station **330** is provided via the charging station controller **320**, in response the charging station controller **320** can reduce the amount of power being delivered to the charging station **330**. Otherwise the charging station controller **320** can communicate a command to the charging station **330** to reduce its power output. For example, the charging station **330** can include a current limiting device configured to reduce the amount of current provided for charging upon command.

In one or more arrangements, one or more of the alerts presented to the customer can provide the customer with opportunity to purchase additional power charging credits and/or gain more credits by making another purchase transaction. For example, an alert can include a link to a web application where the customer can purchase addition power charging credits via the mobile application or web-based application. In one or more arrangements, one or more of the alerts can present a coupon, offer, or other information which the customer may redeem, for example with a clerk and/or at a POS terminal **350**, to purchase items, purchase additional power charging credits, etc.

In one or more arrangement, one or more visible indicators on the charging station **330** can be activated to indicate the first time threshold or the second time threshold, and/or the first power charging threshold or the second power charging threshold, has been reached. In illustration, next to a first LED the charging station **330** can display text indicating less than a certain amount of charging time remains, next to a second LED the charging station **330** can display text indicating no amount of charging time remains, next to a third LED the charging station **330** can display text indicating less than a certain amount of energy consumption remains, and next to a second LED the charging station **330** can display text indicating no amount of energy consumption remains. In one or more examples, the charging station **330** can include a display that indicates the amount of time and/or amount of power remaining. The display also can indicate when various time thresholds and/or energy consumption thresholds have been met.

In one or more arrangements, the number of user devices **360** customers may charge via the charging stations **330-334**, **340-344**, can be limited to a threshold number of user devices **360** (e.g., one, two, three or four). The threshold number of user devices **360** can be a pre-set value, can be determined based on the number of power charging credits assigned to the customers, or can be determined based on customer user profiles. For example, a user profile for the customer can indicate a membership level, and the number of user devices **360** the user may charge at any particular time can be based on that membership level. The transaction server **310** can assign to the customer a membership level based on, for example, the customer's purchase activity with the business and/or other businesses participating in power charging credit sharing over a threshold period of time, for example over the last week, over the last month, over the last year, etc.

In one or more arrangements, the user devices **360** can communicate to the transaction server **310**, either directly or via the charging stations **330-334** and charging station controller **320**, the battery charge level of the user devices **360**. In illustration, via a mobile application or a web browser accessing a web-based application the user device **360** can continually or periodically communicate to the transaction server **310** the present charge level of the battery of the user device. In a non-limiting example, the transaction server can cause the charging station **330** to stop charging the user device **360** or reducing the charging power provided to the user device **360** responsive to the charge level reaching a threshold value, for example, 90%, 95% or 100%. In illustration, the transaction server **310** can communicate a command to the charging station **330** via the charging station controller **320**.

In one or more arrangements, the user devices **360** can communicate to the transaction server **310**, either directly or via the charging stations **330-334** and charging station controller **320**, a rate of energy consumption by the user devices **360** and/or types of customer activity on the user devices **360**. In one or more arrangements, the charging stations **330-334** can communicate to the transaction server **110**, for example via the charging station controller **320**, a rate of energy consumption by the user devices **360**. Based on the rate of energy consumption for individual user devices, the transaction server **310** can determine a type of customer activity on the user devices **360**. In illustration, the transaction server **310** can access an artificial intelligence (AI) computing system that uses machine learning to predict types of user activities on user devices **360** based on energy consumption. In illustration, a particular user device **360** may consume power at a first rate while being used for web browsing, consume power at a second rate while being used for word processing, consume power at a third rate while being used to play videos, consume power at a fourth rate while being used to play games, and so on. Using machine learning the AI system can determine typical energy consumption for particular user device models/hardware configurations based on training data.

In one or more arrangements, the transaction sever **310** can limit the availability of use of the charging stations **330-334** to user devices **360** that are not being used for certain activities. In illustration, a transaction server **310** for a movie theater may be configured to not allow the charging stations **330-334** to be used to charge user devices **360** that are being used to present videos (e.g., movies). For example, in response to determining that a user device **360** is being used to play videos (e.g., based on the energy consumption and/or data received from the user device **360**), the transaction server **310** can command the charging station **330** to stop providing power to the user device **360** or to reduce the amount of current being supplied to the user device **360**. Further, the transaction server **310** can communicate to the user device **360** an alert, for example as previously described, that is presented to the customer indicating that the type of activity the user device **360** is being used for is not permitted in that facility and requesting that the customer cease performing that activity. In another example, the alert can request that the customer reduce the energy consumption by the user device **360**. The transaction sever **310** can wait for a threshold period of time, continuing to monitor the customer activity on the user device **360**, and refrain from ceasing or reducing power delivery to the user device **360** if the customer stops using the user device **360** for the non-permitted activity, or otherwise reduces energy consumption by the user device **360**, for example by stopping video playback.

In one or more arrangements, power charging credits also can be used by customers to access and use power charging lockers. For example, one or more of the charging stations **330-334**, **340-344**, can be components of charging lockers. In illustration, the charging station **334** can be a component of a charging locker **380**. Using the user device **360**, for example a mobile application executing on the user device **360** or a web browser executing on the user device **360** that accesses a web-based application, the customer can request access to a charging locker **380**. In another example, the user

can use a kiosk **382** that is communicatively linked to the transaction server **310** to request access to the charging locker **380**. If the customer does not have enough power charging credits required to have access to a charging locker, the mobile application, web-based application, or kiosk **382** can provide the customer an opportunity to purchase charging credits. Assuming the customer has enough, or has purchased enough, charging credits the transaction server **310** or the kiosk **382** can present to the customer an identifier (e.g., locker number) for the charging locker **380** and provide to the customer access to the charging locker **380**. The kiosk **382**, for example, can manage a charging station controller **320** for the charging locker **380**/charging station **334**.

By way of example, the transaction server **310** can communicate to the user device **360** a code to be presented by the user device **360** to the user, or the kiosk **382** can present the code to the user via a display or printout (e.g., ticket). The user may enter the code into a keypad or touch screen of the charging locker **380** to open the charging locker. In another example, the transaction server **310** or kiosk **382** can communicate to the user device **360** a visible code (e.g., a bar code or QR code), or the kiosk **382** can print the visible code for the user. In an arrangement in which the kiosk **382** communicates the visible code, the kiosk **382** can obtain the customer's e-mail address or instant messaging address from the transaction server **310**.

The customer can present the visible code to a scanner of the charging locker **380** to open the charging locker. In illustration, the transaction server **310** or kiosk **382** can communicate the code or visible code to the charging locker **380**, for example via the charging station controller **320**, and the charging locker **380** can compare that code or visible code it receives to the code or visible code entered or presented by the customer. If the codes or visible codes match, the charging locker **380** can open. The customer can place his/her user device(s) **360** in the charging locker **380** to be charged by coupling the user device(s) **360** to one or more outlets, charging ports and/or wireless chargers of the charging station **334**. The customer can use the same code or visible code to open the charging locker **380** to remove his/her user device(s) **360**.

In another example, the transaction server **310** can access an image of the customer (e.g., the customer's face) or a fingerprint of the customer from the customer's user profile, or the kiosk **382** can capture an image of the customer or a fingerprint of the customer while the customer is at the kiosk. Further, a camera of the charging locker **380** can capture an image of the customer, or a fingerprint scanner of the charging locker can capture an image of the customer's finger pad, for example in response to the customer selecting a key or menu item presented by the charging station, and the charging locker **380** can communicate the captured image to the transaction server **310** or the kiosk **382**. In an arrangement, the customer can interact with the charging locker **380**, for example via a keypad or touchscreen, to initiate the image capture. In another arrangement, the charging locker **380** can monitor for users within a threshold distance, for example as detected by a proximity sensor of the charging locker **380**, and automatically capture the image of a user responsive to detecting the user within the threshold distance. In another arrangement, the camera can continually detect images and the charging locker **380** can select an image in which a face is at least a threshold size in an image.

The transaction server **310** or kiosk **382** can perform image recognition (e.g., facial recognition) on the captured image of the user and compare results of the image recognition to the image of the customer contained in the user profile or the image captured by the kiosk **382**, or the transaction server **310** or kiosk **382** can compare data from the fingerprint scanner to the fingerprint of the customer contained in the user profile or captured by the kiosk **382**. Responsive to the captured image of the user matching the image contained in the user profile or the image captured by the kiosk **382**, or the fingerprint scan matching the fingerprint in the customer's user profile or captured by the kiosk **382**, the transaction server **310** or kiosk **382** can communicate a command to the charging locker **380**, for example via the charging station controller **320**, that causes the charging locker **380** to open.

In another arrangement, the charging locker **380** can request from the transaction server **310** or the kiosk **382** the image of the customer or the fingerprint of the customer contained in the customer's user profile or captured by the kiosk **382**. In such arrangement, the charging locker **380** can perform the image recognition on the captured image of the user and compare results of the image recognition to the accessed image of the customer, or the charging locker **380** can compare data from the fingerprint scanner to the fingerprint of the customer. Responsive to the captured image of the user matching the image in the customer's user profile or captured by the kiosk **382**, or the fingerprint scan matching the fingerprint in the customer's profile or captured by the kiosk **382**, the charging locker **380** can automatically open.

In an arrangement in which the charging locker **380** automatically captures the customer's image, the charging locker **380** can automatically open without the customer needing to touch a keypad or touchscreen. Again, the customer can place his/her user device(s) **360** in the charging locker **380** to be charged using one or more outlets, charging ports or wireless charging. The customer can initiate the charging locker **380** to scan the customer's image or fingerprint to open the charging locker **380** to remove his/her user device(s).

In one or more arrangements the charging stations **330-334** can be distributed around a facility, for example a mall, an amusement park, an arena, etc. Via a mobile application or a web browser executing on a user device **360**, a customer can access a map that indicates where the charging stations **330-334**. The map also can indicate which charging stations **330-334** currently are available. The map can be provided, for example, by the transaction server **310**, which the customer can access via the mobile application or web browser. If there are charging stations **330-334** currently available, via the mobile application or web browser the customer can request to be added to a waiting list. The transaction server **310** can communicate an alert the user device **360** of the customer when a charging station **330** becomes available, for example as previously described. Further, the alert can present the map and indicate to the map where the available charging station **330** is located.

As noted, the transaction server **310** can track the customer's location via the beacons **370**. In one or more arrangements, the user device **360** can communicate to the transaction server **310** the user device's global positioning system (GPS) coordinates, and the transaction server **310** can identify the customer's location using the GPS coordinates. In one or more arrangements, the transaction server **310** can identify the customer's location by accessing coordinates of the user device **360** provided by the customer's mobile communications provider based on performing triangulation or trilateration of mobile communication signals

(e.g., cellular communication signals) communicated by the user device **360**. Having knowledge of the customer's location, the transaction server **310** can indicate in the map the customer's location on the map and one or more routes for the customer to get to the charging station **330**.

In one or more arrangements, the transaction server **310** can communicate to the user device **360** an alert presenting one or more coupons, offers, etc. for one or more establishments located within a threshold distance of one or more of the charging stations **330-334**, or for establishments in which the charging stations **330-334** are located. This can serve to generate business for such establishments.

In one or more arrangements, in addition to tracking the customer's location, the transaction server **310** can monitor the battery level(s) of the customer's user device(s) **360**. For example, a mobile application on a user device **360** can be configured to communicate battery level information to the transaction server **310**. Responsive to the transaction server **310** determining that the battery level is below a threshold value, the transaction server **310** can identify, from among the charging stations **330-334** that are currently available, a charging station **330** that is closest to the customer's current location. Further, the transaction server **310** can communicate an alert, for example as previously described, indicating to the user that the battery level is below the threshold value and that the charging station **330** currently is available. The alert also can present a map indicating where the charging station **330** is located, the customer's present location, and one or more routes for the customer to get to the charging station **330**. Again, the one or more coupons, offers, etc. for one or more establishments within a threshold distance of the charging station, or an establishment in which the charging station **330** is located.

The foregoing arrangements and examples assume customer authorization to participate in the various processes. For example, via a mobile application or web-based application, the customer can opt in or opt out of various processes, such as location tracking, monitoring and/or tracking of certain customer activities, etc. Moreover, it is anticipated that customers will take affirmative actions via the mobile application or web-based application to create a user account and participate in the power charging program.

In one or more arrangements, the transaction server **310** can assign the power charging credits to the customer, or deduct power charging credits used by the customer, using a distributed ledger, for example blockchains. In illustration, the transaction server **310** can create one or more blockchain blocks **390** indicating the assignment of the power charging credits to the customer or deduction of power charging credits from the customer. For instance, the transaction server **310** can create a blockchain block **390** including the customer's user ID, the customer's passcode/password, the power charging credits earned by the customer for the in-store transaction, and the power charging credits used by the customer, if any. Optionally, the transaction server **310** also can include in the block **390** additional information, for example data indicating a power charging blockchain **392** to which the block **390** is assigned, data indicating a duration of time for which the power charging credits remain available, data indicating a maximum amount of time one or more user devices **360** may be charged in a particular time period (e.g., per hour, per day, per week, etc.), data indicating a date/time when the power charging credits expire, data indicating user devices **360** for which the power charging credits may be used to charge, data indicating whether the power charging credits are transferable to other users, data indicating a membership level, data indicating a number of user devices that may be simultaneously charged, data indicating make, model, configuration, etc. of one or more of the customer's user devices, data indicating the customer's usage of charging stations **330-334**, data indicating an instant messaging address and/or e-mail address of the customer, data indicating the customer's determined activities while using one or more charging stations **330-334**, a link to the customer's user profile, and so on. Once created, the blockchain block **390** can be read-only and immutable. This can serve to make transactions recorded in the power charging blockchain **392** immutable and secure from tampering.

The transaction server **310** can communicate, via the cloud computing environment **50** or simply via the Internet, the block **390** to one or more other transaction servers **312** (or other data processing systems) participating in the power charging blockchain **392** to which the block **390** is assigned. For example, if a store is part of a franchise having numerous store locations and a plurality of transaction servers **310**, **312**, the transaction server **310** can communicate the block **390** to each of the other transaction servers **312**. In another example the store, regardless of whether it is part of a franchise, may be part of an agreement allowing for power charging credits that the store issues to be used at other stores and facilities, and for power charging credits that other stores issue to be used at the store. Thus, the store and each of the other stores/facilities can participate in the power charging blockchain **392**. In such an arrangement, the transaction server **310** can communicate the block **390** to transaction servers **312** (or other data processing systems) of each of the other stores/facilities participating in that power charging blockchain **392**.

Responsive to the other transaction servers **312** (or other data processing systems) receiving the block **390**, the other transaction servers **312** (or other data processing systems) can validate the block **390** and add the block **390** to their copy of the power charging blockchain **392**. Each of the transaction servers **310**, **312** (or other data processing systems) can synchronize their copy of the power charging blockchain **392** from time to time using peer-to-peer blockchain synchronization using known blockchain synchronization techniques.

The use of the power charging blockchain **392** allows the customer to use his/her power charging credits to use other charging stations **340-344** and/or charging lockers **384** at other stores and facilities. For example, the customer can use his/her power charging credits at a kiosk **386** to gain access to the charging locker **384**, for example as previously described. Further, the customer can use his/her power charging credits to use other charging stations **330-334** at the store, as well as charging stations **330-334** at other stores and facilities without having to make additional purchases.

In illustration, the customer can use a mobile application executing on the customer's user device **360** to communicatively link to any of the charging stations **330-334**, **340-344**, and/or charging lockers **380**, **384**. For example, the user device **360** can link to the charging station **344** or charging locker **384** using a PAN (e.g., Bluetooth® or BTE). In another example, the user device **360** can link to the charging station **344** via a communication cable (e.g., USB cable or Lightening cable) plugged into a charging port of the charging station **344**. In an arrangement in which the user device **360** and charging station **344** support powerline communication, the user device **360** can link to the charging station **344** via powerline communication through a power outlet of the charging station **344**.

Regardless of the type of communication link, via the communication link the mobile application can interface with the transaction server **312**, for example via the charging station **344** or via the charging locker **384** and the charging station controller **322**. Using the mobile application, the customer can request charging privileges on the charging station **344**, or request access to the charging locker **384** and charging privileges on the charging station **340**. For example, the mobile application can communicate the customer's user ID and password or passcode to the transaction server **312**. Using the customer's user ID and password or passcode, the transaction server **312** can access one or more blocks **390** of in the power charging blockchain **392** that pertain to the customer.

The transaction server **312** can determine whether the customer has sufficient available power charging credits to use the charging station **344** or charging locker **384**. For example, the transaction server **312** can determine a total of available charging credits by summing all of the power charging credits assigned to the customer in blocks **390** of the blockchain **192**, and from the sum of the power charging credits deduct a sum of the power charging credits deducted from the customer in blocks **390** of the blockchain **192**. The power charging credits that are deducted from the customer can be power charging credits that have been used by the customer or transferred by the customer to another user. The determination of whether the sufficient available power charging credits to use the charging station **344** or charging locker **384** can be based on, for example, whether the total of available charging credits for the customer meets or exceeds a threshold value, for example at least equal to one charging credit, two charging credits, five charging credits, etc.

If the transaction server **312** determines the customer has sufficient available power charging credits to use the charging station **344** or charging locker **384**, the transaction server **312** can provide charging privileges on the charging station **344**, or access to the charging locker **384** and charging privileges on the charging station **340**. The transaction server **312** and charging station controller **322** also can perform any of the other processes previously described as being performed by the transaction server **310** and charging station controller **320**, including, but not limited to, generating alerts, ceasing or reducing power delivery, deducting power charging credits based on energy consumption and/or usage of the charging locker **384**, adding additional blockchain blocks **390** for the customer to the power charging blockchain **392**, communicating the additional blockchain blocks **390** to other transaction servers **310** and data processing systems participating in the power charging blockchain **392**, and so on. The additional blockchain blocks **390** can include power charging credit deductions and additions, energy consumption data, user device **360** data, customer activities while using the user device(s) **360**, as well as any additional data that may be added to a block, for example other data previously described.

If the transaction server **312** determines the customer does not have sufficient available power charging credits to use the charging station **344** or charging locker **384**, via a mobile application or web-based application, the transaction server **312** can present to the customer an offer to purchase power charging credits and/or present a recommendation for the customer to purchase a good and/or service to earn power charging credits, for example as previously described.

In one or more arrangements, via a mobile application or web-based application, the customer can transfer at least a portion of his/her power charging credits to one or more other users. For example, the user can indicate the number of power charging credits to transfer and a user ID of a user to whom the power charging credits are to be transferred. In response, the transaction server **310**, **312** with which the application or web-based application is interfacing can create a new blockchain block **390** for the power charging blockchain **392** for the customer containing data indicating at least the user ID of the customer, the user ID of the user to whom the power charging credits are being transferred, and the number of power charging credits being transferred. The new blockchain block **390** also can include other data, for example one or more types of other data previously described. Another blockchain block **390** can be created for the user to whom the power charging credits are being transferred and added for that user to the power charging blockchain **392**. For instance, the other block can indicate the user ID of the user to whom the power charging credits are being transferred, the user ID of the customer from whom the power charging credits were received, the number of power charging credits being transferred, etc. The other user may use the transferred power charging credits to use charging stations **330-334**, **340-344** and power charging lockers **380**, **384** as previously described.

In some circumstances the number of available charging stations **330-334**, **340-344**, and/or charging lockers **380**, **384** maybe scarce. Indeed, the availability may not meet demand. Using a mobile application or web-based application, customers/users may bid for access to the charging stations **330-334**, **340-344**, and/or charging lockers **380**, **384** located within a threshold distance of their respective locations. Responsive to receiving a bid, the transaction server **310** can create another blockchain block **390** indicating the user ID of the user (e.g., customer or other user) placing the bid, the number of power charging credits being bid, and the current location of the user placing the bid. The transaction server **310** also may include any other pertinent data in the new blockchain block **390**. The transaction server **310** can add the new blockchain block **390** to the power charging blockchain **392** for the user, add the new blockchain **390** to the power charging blockchain **392** residing at the transaction server **310**, and communicate the new blockchain **390** to other transaction servers **312** and data processing systems participating in the power charging blockchain **392**, and so on.

Further, the transaction servers **310**, **312** can monitor the charging stations **330-334**, **340-344** and/or charging lockers **380**, **384** for availability, and assign available charging stations **330-334**, **340-344** and/or charging lockers **380**, **384** to users within a threshold distances of those charging stations **330-334**, **340-344** and/or charging lockers **380**, **384** who have placed the highest bids. In illustration, responsive to determining a charging station **330** is available, the transaction server **310** can process the power charging blockchain **392** to determine whether there are any users within a threshold distance of the charging station **330** that have placed a bid for use of a charging station or charging station **330-334**, **340-344**. The transaction server **310** can access an AI system to facilitate this process.

If there are one or more users within a threshold distance of the charging station **330** that have placed a bid for use of a charging station, the transaction server **310** can select the user who placed the highest bid and communicate an alert to that user indicating the charging station **330** is available and the location of the charging station **330**. For example, the transaction server can communicate the alert to a mobile application executing on the user's user device **360**, an instant messaging address of the user or email address of the

user. The transaction server **310** can monitor the charging station **330** for coupling the user's user device **360** to the charging station **330**. If such coupling is not detected within a threshold period of time, the transaction servers **310** can select a next highest bidder and communicate an alert to that user, and so on. Responsive to detecting the user coupling to the charging station **330**, the transaction server **310** can activate power of the charging station **330** and begin monitoring usage of the charging station **330** by the user, for example as previously described, and perform actions previously described to monitor power station usage, deduct power charging credits based on that usage, etc. If a user other than the user who won the bid couples to the charging station **330**, the transaction server **310** can initiate the charging station **330** to generate an alert indicating that the charging station **330** is reserved and not available, for example by rapidly flashing lights (e.g., LEDs), presenting text on a display and/or generating an audible tone. In such case, the transaction server **110** would not activate power delivery to the charging station **330** for the improper user.

In one or more arrangements, users may bid on a certain amount of usage, for example time, energy consumption, number of user devices **360** to be charged, etc. Upon expiration of the time and/or the energy consumption limit being reached, the transaction server **310** can communicate an alert to the user device **360** of the user, for example as previously described, alerting the user that the time and/or the energy consumption limit has been reached. Optionally, the alert can indicate additional time and/or energy consumption that may be provided using available power charging credits of the user and/or offering the user to purchase additional power charging credits. In one or more arrangements, the transaction server **310** can access an AI system that determines the number of power charging credits to charge the user based on various industry models and past data.

In one or more arrangements, as a user moves the transaction server **310** can generate additional blockchain blocks **390** for the user, for example at a periodic interval (e.g., every minute, every five minutes, every ten minutes, etc.), add the additional blockchain blocks **390** to the power charging blockchain **392** residing at the transaction server **310**, and communicate the additional blockchain blocks **390** to other transaction servers **312** and other data processing systems participating in the power charging blockchain **392**. Accordingly, if the user is moving, the user's bid will be applied to an available charging station or charging locker **380**, **384** within a threshold distance of the user's current location.

FIG. **4** is a block diagram illustrating example architecture for the charging station **330**. The charging stations **331-3334**, **340-344** can be configured in a similar manner.

The charging station **330** can include a processor **402** (e.g., central processing unit, controller, application specific integrated circuit, etc.) coupled to memory elements **404** through a system bus or other suitable circuitry. As such, the charging station **330** can store program code within the memory elements **404**. The processor **402** can execute the program code accessed from the memory elements **404** via the system bus. The memory elements **404** can include, for example, local memory and one or more bulk storage devices. Local memory refers to random access memory (RAM) or other non-persistent memory device(s) generally used during actual execution of the program code. The bulk storage device(s) can be implemented as a hard disk drive (HDD), solid state drive (SSD), or other persistent data storage device. The charging station **330** also can include one or more cache memories (not shown) that provide temporary storage of at least some program code in order to reduce the number of times program code must be retrieved from the local memory and/or bulk storage device during execution.

The charging station **330** also can include one or more power charging ports **410**, one or more power outlets **412** and/or one or more wireless chargers **414**. Examples of the power charging ports **410** include, but are not limited to, USB ports, Lightening ports, IEEE 1394 (FireWire) ports, and the like. The power outlet **412** can include a power socket configured to receive a conventional AC power plug. The wireless charger **414** can be, for example, an inductive charger comprising an induction coil, for example in accordance with the Qi wireless charging standard.

The charging station **330** also can include a power regulator **420** for the power charging port(s) **410**, a power regulator **422** for the power outlet(s) **412** and a power regulator **424** for the wireless charger(s) **414**. Each of the power regulators **420**, **422**, **424** can receive electrical power **426** (e.g., AC power) from an electrical system, for example via an AC power plug or by being hard-wired into the electrical system. The power regulator **420** can convert the electrical power **426** to DC voltage, for example 5 VDC. Further, the power regulator **420** can be activated and deactivated by the processor **402** to turn on and turn off power delivery via the power charging port(s) **410**. Further, the power regulator **420** can be controlled by the processor **402** to regulate the level of DC current provided to the power charging port(s) **410**. The power regulator **422** can be activated and deactivated by the processor **402** to turn on and turn off power delivery via the power outlet(s) **412**. Further, the power regulator **422** can be controlled by the processor **402** to regulate the level of AC current provided to the power outlet(s) **412**. In an arrangement in which the voltage provided by the power outlet(s) **412** is different that the voltage of the electrical power **426**, the charging station **330** further can include a transformer (not shown) in-line with the power regulator **422** that steps the voltage up or down. The power regulator **424** can be activated and deactivated by the processor **402** to turn on and turn off power delivery via the wireless charger(s) **414**. Further, the power regulator **422** can be controlled by the processor **402** to regulate the level of wireless charging power provided by the wireless charger(s) **414**.

The charging station **330** also can include a power sensor **430** that measures power consumption by user devices **360** through the power charging port(s) **410**, a power sensor **432** that measures power consumption by user devices **360** through the power outlet(s) **412** and a power sensor **434** that measures power consumption by user devices **360** through the wireless charger(s) **414**. The power sensors **430**, **432**, **434** can comprise for example, current sensors. In illustration, the processor can receive current level data from each of the power sensors **430**, **432**, **434** and, based on that data and the respective voltages, compute the respective energy consumption. In a non-limiting example, one or more of the power sensors **430**, **432**, **434** can include a voltage sensor. The processor **402** can receive voltage level data from the respective power sensors **430**, **432**, **434** for use in computing the respective energy consumption. In another example, the respective voltages can be predetermined, and thus voltage sensors not needed.

In an arrangement in which the charging station **330** implements powerline communication with the charging station controller **320** and/or user devices **360**, the charging station **330** can include a powerline network adapter **440**.

The powerline network adapter **440** can be coupled to the electrical power **426** and/or to the power outlet(s) **412**. The powerline network adapter **440** can communicate data between the processor **402** and the charging station controller **320** via the electrical wiring that provides the electrical power **426**, communicate data between the processor **402** and user devices coupled to the power outlet(s) **412**, and communicate data between user devices coupled to the power outlet(s) **412** and the charging station controller **320** via the electrical wiring that provides the electrical power **426**.

The charging station **330** can include an input/output (I/O) controller **442** that controls communication between the processor **402** and user devices **360** coupled to the power charging port(s) **410**. The processor **402** can exchange such data with the charging station controller **320** and/or the transaction server **310**. For example, the processor can exchange such data with the charging station controller **320** via the powerline network adapter **440** and/or one or more network adapters **444**. Modems, cable modems, Ethernet cards and wireless transceivers are examples of different types of network adapters **444** that can be used with the charging station **330**. The transceivers can include, for instance, a PAN transceiver a WiFi transceiver.

The charging station **330** also can include one or more visual indicators **450**, for example LED lights, LED displays, etc., via which the processor **402** presents visual alerts. The charging station **330** also can include one or more output audio transducers **452** via which the processor **402** presents audible alerts. The charging station **330** may include an audio controller (not shown) to which the processor **402** communicates digital audio signals. The audio controller can convert the digital audio signals to analog audio signals, amplify the analog audio signals, and communicate the amplified audio signals to the output audio transducer(s) **452**.

FIG. **5** is a perspective view of an example of a charging locker **380**. The charging locker **384** can be configured in a similar manner.

The charging locker can include a secure box **500** comprising a plurality of sides, for example a left side **502**, a right side **504**, a top side **506**, a bottom side **508** and a back side **510**. Further, the secure box can include a door **512** attached to the left side **502**, right side **504**, top side **506** or bottom side **508** via a hinge **514**. The door **512** can include a handle **516**. The charging locker **380** also can include an electronically actuated lock **518** attached to one of the sides **502**, **504**, **506**, **508** and configured to lock the door **512** in a closed position against front facing edges of the sides **502**, **504**, **506**, **508**. The lock **518** can include a sensor that detects whether the door **512** is in the closed position. The charging locker **380** also can include a door actuator **520** or spring that automatically opens the door **512** in response to the lock **518** being released.

Further, the charging locker **380** can include the charging station **334** which, as noted, can be configured in a manner similar to the charging station **330** of FIG. **4**. The charging station **334** can include, for example, one or more power charging ports **410**, one or more power outlets **412** and/or one or more wireless chargers **414**. In an arrangement in which the box **500** is made of metal, an antenna (not shown) of a transceiver of the network adapter(s) **444** (FIG. **4**) can be mounted external to the box **500** and connected to the transceiver via wires routed through a hole in the box, for example on the back side **510**. External electrical wiring and networking cables connected to the charging station **334** can be routed through a hole in the box, for example on the back side **510**.

The electronically actuated lock **518** and door actuator **520** can be communicatively linked to the processor **402** (FIG. **4**) of the charging station **334**, for example via relays. The processor **402** can be configured to activate relays to actuate the lock **518** between a locked state and an unlocked state. The processor **402** also can be configured to actuate the door actuator **520** via a relay to open the door **512** in response to the lock **518** being actuated into an unlocked state.

The charging locker **380** also can include a user interface **530**, which will be described in further detail in FIG. **6**. Components of the user interface **530** can be communicatively linked to the processor **402**, for example via wiring in the charging locker **380**. The processor **402** can receive and process data received from data generating components of the user interface **530**, as well as communicate data to information presentation components of the user interface **530**.

FIG. **6** depicts an example of the user interface **530** of a charging locker **380**. The user interface **530** can include a keypad **600**, a camera **602**, a fingerprint sensor **604** and a display **606**. A user can depress keys **608** of the keypad **600** to enter a passcode to unlock the charging locker **380**. In illustration, the keypad **600** can communicate data corresponding to each key **608** depression to the processor **402**. Responsive to the proper key combination being entered when the lock **518** (FIG. **5**) is in the locked state, the processor **402** can actuate the lock **518** to the unlocked state. Further, the processor **402** can actuate the door actuator **520** to open the door **512**. Responsive to a proper key combination being entered, or simply a single key being depressed, when the lock **518** (FIG. **5**) is in the unlocked state and the sensor of the lock **518** indicates the door **512** is in the closed position, the processor **402** can actuate the lock **518** to the locked state, thus locking the door closed. In this regard, the sensor of the lock **518** can be communicatively linked to the processor **402**.

The camera **602**, fingerprint sensor **604** and display **606** each can be communicatively linked to the processor **402** and communicate respective data to the processor **402**. Responsive to the camera **602** capturing an image of an authorized user of the charging locker **380**, or responsive to the fingerprint sensor capturing a fingerprint of an authorized user of the charging locker **380**, when the lock **518** is in the locked state, the processor **402** can actuate the lock **518** to the unlocked state. Further, the processor **402** can actuate the door actuator **520** to open the door **512**. Responsive to the camera **602** capturing an image of an authorized user of the charging locker **380**, or responsive to the fingerprint sensor capturing a fingerprint of an authorized user of the charging locker **380**, when the lock **518** is in the unlocked state and the sensor of the lock **518** indicates the door **512** is in the closed position, the processor **402** can actuate the lock **518** to the locked state, thus locking the door closed.

Via the display **606** the processor **402** can present various information to the user. For example, the processor **402** can present information indicating the charge level of one or more user devices **360** being charged by the charging station **334**, an amount of power charging credit deductions thus far accumulated for use of the charging locker **380**, an amount of the user's available power charging credits, special offers to the user, and so on.

FIG. **7** is a block diagram illustrating example architecture for the charging station controller **320**. The charging station controller **322** can be configured in a similar manner.

The charging station controller **320** can include a processor **702** (e.g., central processing unit, controller, application specific integrated circuit, etc.) coupled to memory elements **704** through a system bus or other suitable circuitry. As such, the charging station controller **320** can store program code within the memory elements **704**. The processor **702** can execute the program code accessed from the memory elements **704** via the system bus. The memory elements **704** can include, for example, local memory and one or more bulk storage devices. The charging station controller **320** also can include one or more cache memories (not shown) that provide temporary storage of at least some program code in order to reduce the number of times program code must be retrieved from the local memory and/or bulk storage device during execution.

The charging station controller **320** also can include one or more network adapters **706**. Modems, cable modems, Ethernet cards and wireless transceivers are examples of different types of network adapters **706** that can be used with the charging station controller **320**. The transceivers can include, for instance, a PAN transceiver a WiFi transceiver. The charging station controller **320** can communicate with the transaction server **310** via the network adapter(s) **706**.

The charging station controller **320** also can include one or more powerline network adapters **708**. The charging station controller **320** can communicate with charging stations **330-334** via the powerline network adapters over electrical lines providing power to the charging stations **330-334** and/or communicate with the charging stations **330-334** via the network adapter(s) **706**.

As noted, in another arrangement, the charging station controller **320** can be a component of the transaction server **310**. In such an arrangement, the processor, memory elements, network adapter(s) and powerline network adapter of the transaction server **310** also may be used as the processor **702**, memory elements **704**, network adapter(s) **706** and powerline network adapter **708** of the charging station controller **320**.

FIG. **8** is a block diagram illustrating example architecture for the transaction server **310**. The transaction server **310** can include a processor **802** (e.g., central processing unit, controller, application specific integrated circuit, etc.) coupled to memory elements **804** through a system bus or other suitable circuitry. As such, the transaction server **310** can store program code within the memory elements **804**. The processor **802** can execute the program code accessed from the memory elements **804** via the system bus. The memory elements **804** can include, for example, local memory and one or more bulk storage devices. The transaction server **310** also can include one or more cache memories (not shown) that provide temporary storage of at least some program code in order to reduce the number of times program code must be retrieved from the local memory and/or bulk storage device during execution.

The transaction server **310** also can include one or more network adapters **806**. Modems, cable modems, Ethernet cards and wireless transceivers are examples of different types of network adapters **806** that can be used with the charging station controller **320**. The transceivers can include, for instance, a PAN transceiver a WiFi transceiver.

In an arrangement in which the transaction server **310** comprises the charging station controller **320**, the transaction server **310** also can include one or more powerline network adapters **808**. The transaction server **310** can communicate with charging stations **330-334** via the powerline network adapters over electrical lines providing power to the charging stations **330-334** and/or communicate with the charging stations **330-334** via the network adapter(s) **806**.

FIG. **9** is a flowchart illustrating an example of a method **900** of providing a power charging service. The method can be implemented by the transaction server **310** and/or the transaction server **312**. At step **902**, the transaction server **310** can detect an in-store customer transaction. At step **904**, the transaction server **310** can assign power charging credits to the customer based, at least in part, on the in-store customer transaction. At step **906**, the transaction server **310** can activate a charging station for the customer. At step **908**, the transaction server **310** can determine, using a processor, whether an amount of energy consumption by at least one user device of the customer from the charging station has reached a threshold value, the threshold value based, at least in part, on the power charging credits assigned to the customer. At step **910**, the transaction server **310** can, responsive to determining that the energy consumption by the at least one user device of the customer from the charging station has reached the threshold value, initiate the charging station to cease or reduce power being delivered by the charging station to the at least one user device of the user.

The foregoing description is just an example of embodiments of the invention, and variations and substitutions. While the disclosure concludes with claims defining novel features, it is believed that the various features described herein will be better understood from a consideration of the description in conjunction with the drawings. The process(es), machine(s), manufacture(s) and any variations thereof described within this disclosure are provided for purposes of illustration. Any specific structural and functional details described are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the features described in virtually any appropriately detailed structure. Further, the terms and phrases used within this disclosure are not intended to be limiting, but rather to provide an understandable description of the features described.

The present invention may be a system, a method, and/or a computer program product at any possible technical detail level of integration. The computer program product may include a computer readable storage medium (or media) having computer readable program instructions thereon for causing a processor to carry out aspects of the present invention.

The computer readable storage medium can be a tangible device that can retain and store instructions for use by an instruction execution device. The computer readable storage medium may be, for example, but is not limited to, an electronic storage device, a magnetic storage device, an optical storage device, an electromagnetic storage device, a semiconductor storage device, or any suitable combination of the foregoing. A non-exhaustive list of more specific examples of the computer readable storage medium includes the following: a portable computer diskette, a hard disk, a random access memory (RAM), a read-only memory (ROM), an erasable programmable read-only memory (EPROM or Flash memory), a static random access memory (SRAM), a portable compact disc read-only memory (CD-ROM), a digital versatile disk (DVD), a memory stick, a floppy disk, a mechanically encoded device such as punch-cards or raised structures in a groove having instructions recorded thereon, and any suitable combination of the foregoing. A computer readable storage medium, as used herein,

is not to be construed as being transitory signals per se, such as radio waves or other freely propagating electromagnetic waves, electromagnetic waves propagating through a waveguide or other transmission media (e.g., light pulses passing through a fiber-optic cable), or electrical signals transmitted through a wire.

Computer readable program instructions described herein can be downloaded to respective computing/processing devices from a computer readable storage medium or to an external computer or external storage device via a network, for example, the Internet, a local area network, a wide area network and/or a wireless network. The network may comprise copper transmission cables, optical transmission fibers, wireless transmission, routers, firewalls, switches, gateway computers and/or edge servers. A network adapter card or network interface in each computing/processing device receives computer readable program instructions from the network and forwards the computer readable program instructions for storage in a computer readable storage medium within the respective computing/processing device.

Computer readable program instructions for carrying out operations of the present invention may be assembler instructions, instruction-set-architecture (ISA) instructions, machine instructions, machine dependent instructions, microcode, firmware instructions, state-setting data, configuration data for integrated circuitry, or either source code or object code written in any combination of one or more programming languages, including an object oriented programming language such as Smalltalk, C++, or the like, and procedural programming languages, such as the "C" programming language or similar programming languages. The computer readable program instructions may execute entirely on the user's computer, partly on the user's computer, as a stand-alone software package, partly on the user's computer and partly on a remote computer or entirely on the remote computer or server. In the latter scenario, the remote computer may be connected to the user's computer through any type of network, including a local area network (LAN) or a wide area network (WAN), or the connection may be made to an external computer (for example, through the Internet using an Internet Service Provider). In some embodiments, electronic circuitry including, for example, programmable logic circuitry, field-programmable gate arrays (FPGA), or programmable logic arrays (PLA) may execute the computer readable program instructions by utilizing state information of the computer readable program instructions to personalize the electronic circuitry, in order to perform aspects of the present invention.

Aspects of the present invention are described herein with reference to flowchart illustrations and/or block diagrams of methods, apparatus (systems), and computer program products according to embodiments of the invention. It will be understood that each block of the flowchart illustrations and/or block diagrams, and combinations of blocks in the flowchart illustrations and/or block diagrams, can be implemented by computer readable program instructions.

These computer readable program instructions may be provided to a processor of a computer, or other programmable data processing apparatus to produce a machine, such that the instructions, which execute via the processor of the computer or other programmable data processing apparatus, create means for implementing the functions/acts specified in the flowchart and/or block diagram block or blocks. These computer readable program instructions may also be stored in a computer readable storage medium that can direct a computer, a programmable data processing apparatus, and/or other devices to function in a particular manner, such that the computer readable storage medium having instructions stored therein comprises an article of manufacture including instructions which implement aspects of the function/act specified in the flowchart and/or block diagram block or blocks.

The computer readable program instructions may also be loaded onto a computer, other programmable data processing apparatus, or other device to cause a series of operational steps to be performed on the computer, other programmable apparatus or other device to produce a computer implemented process, such that the instructions which execute on the computer, other programmable apparatus, or other device implement the functions/acts specified in the flowchart and/or block diagram block or blocks.

The flowchart and block diagrams in the Figures illustrate the architecture, functionality, and operation of possible implementations of systems, methods, and computer program products according to various embodiments of the present invention. In this regard, each block in the flowchart or block diagrams may represent a module, segment, or portion of instructions, which comprises one or more executable instructions for implementing the specified logical function(s). In some alternative implementations, the functions noted in the blocks may occur out of the order noted in the Figures. For example, two blocks shown in succession may, in fact, be accomplished as one step, executed concurrently, substantially concurrently, in a partially or wholly temporally overlapping manner, or the blocks may sometimes be executed in the reverse order, depending upon the functionality involved. It will also be noted that each block of the block diagrams and/or flowchart illustration, and combinations of blocks in the block diagrams and/or flowchart illustration, can be implemented by special purpose hardware-based systems that perform the specified functions or acts or carry out combinations of special purpose hardware and computer instructions. The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms "a," "an," and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "includes," "including," "comprises," and/or "comprising," when used in this disclosure, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms "a," "an," and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "includes," "including," "comprises," and/or "comprising," when used in this disclosure, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

Reference throughout this disclosure to "one embodiment," "an embodiment," "one arrangement," "an arrangement," "one aspect," "an aspect," or similar language means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment described within this disclosure. Thus, appearances of the phrases "one embodiment," "an embodi-

ment," "one arrangement," "an arrangement," "one aspect," "an aspect," and similar language throughout this disclosure may, but do not necessarily, all refer to the same embodiment.

The term "plurality," as used herein, is defined as two or more than two. The term "another," as used herein, is defined as at least a second or more. The term "coupled," as used herein, is defined as connected, whether directly without any intervening elements or indirectly with one or more intervening elements, unless otherwise indicated. Two elements also can be coupled mechanically, electrically, or communicatively linked through a communication channel, pathway, network, or system. The term "and/or" as used herein refers to and encompasses any and all possible combinations of one or more of the associated listed items. It will also be understood that, although the terms first, second, etc. may be used herein to describe various elements, these elements should not be limited by these terms, as these terms are only used to distinguish one element from another unless stated otherwise or the context indicates otherwise.

The term "if" may be construed to mean "when" or "upon" or "in response to determining" or "in response to detecting," depending on the context. Similarly, the phrase "if it is determined" or "if [a stated condition or event] is detected" may be construed to mean "upon determining" or "in response to determining" or "upon detecting [the stated condition or event]" or "in response to detecting [the stated condition or event]," depending on the context.

The descriptions of the various embodiments of the present invention have been presented for purposes of illustration, but are not intended to be exhaustive or limited to the embodiments disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art without departing from the scope and spirit of the described embodiments. The terminology used herein was chosen to best explain the principles of the embodiments, the practical application or technical improvement over technologies found in the marketplace, or to enable others of ordinary skill in the art to understand the embodiments disclosed herein.

What is claimed is:

1. A method, comprising:

detecting an in-store customer transaction;

assigning power charging credits to the customer based, at least in part, on the in-store customer transaction;

activating a charging station for the customer;

determining, using a processor, whether an amount of energy consumption by at least one user device of the customer from the charging station has reached a threshold value, the threshold value based, at least in part, on the power charging credits assigned to the customer; and

responsive to determining that the energy consumption by the at least one user device of the customer from the charging station has reached the threshold value, initiating the charging station to cease or reduce power being delivered by the charging station to the at least one user device of the user.

2. The method of claim **1**, further comprising:

tracking a path of the customer with respect to locations of a plurality of charging stations at a facility;

determining that the charging station, from among those of the plurality charging stations that currently are available, is nearest to a current location of the customer; and

activating the charging station based, at least in part, on the customer remaining within a threshold distance of the charging station at least a threshold period of time.

3. The method of claim **2**, further comprising:

generating an alert, presented on the user device, indicating to the customer the determined charging station is available for use by the customer to charge the device.

4. The method of claim **1**, further comprising:

responsive to determining that the energy consumption by the at least one user device of the customer from the charging station has reached a threshold value, generating an alert on the user device that provides the customer with opportunity to purchase additional power charging credits.

5. The method of claim **1**, wherein the assigning the power charging credits to the customer comprises:

assigning the power charging credits to the customer using a distributed ledger.

6. The method claim **5**, further comprising:

wherein the assigning the power charging credits to the customer using the distributed ledger comprises automatically generating a block for a blockchain, the block indicating at least a user identifier for the user and an indication of an amount of the power charging credits assigned to the customer.

7. The method of claim **5**, further comprising:

transferring at last a portion of the power charging credits from the customer to a user by automatically generating a block for a blockchain, the block indicating at least a user identifier of the customer, a user identifier of the user, and an indication of an amount of the power charging credits that are being transferred.

8. A system, comprising:

a processor programmed to initiate executable operations comprising:

detecting an in-store customer transaction;

assigning power charging credits to the customer based, at least in part, on the in-store customer transaction;

activating a charging station for the customer;

determining whether an amount of energy consumption by at least one user device of the customer from the charging station has reached a threshold value, the threshold value based, at least in part, on the power charging credits assigned to the customer; and

responsive to determining that the energy consumption by the at least one user device of the customer from the charging station has reached the threshold value, initiating the charging station to cease or reduce power being delivered by the charging station to the at least one user device of the user.

9. The system of claim **8**, the executable operations further comprising:

tracking a path of the customer with respect to locations of a plurality of charging stations at a facility;

determining that the charging station, from among those of the plurality charging stations that currently are available, is nearest to a current location of the customer; and

activating the charging station based, at least in part, on the customer remaining within a threshold distance of the charging station at least a threshold period of time.

10. The system of claim **9**, the executable operations further comprising:

generating an alert, presented on the user device, indicating to the customer the determined charging station is available for use by the customer to charge the device.

11. The system of claim 8, the executable operations further comprising:

responsive to determining that the energy consumption by the at least one user device of the customer from the charging station has reached a threshold value, generating an alert on the user device that provides the customer with opportunity to purchase additional power charging credits.

12. The system of claim 8, wherein the assigning the power charging credits to the customer comprises:

assigning the power charging credits to the customer using a distributed ledger.

13. The system of claim 12, the executable operations further comprising:

wherein the assigning the power charging credits to the customer using the distributed ledger comprises automatically generating a block for a blockchain, the block indicating at least a user identifier for the user and an indication of an amount of the power charging credits assigned to the customer.

14. The system of claim 12, the executable operations further comprising:

transferring at last a portion of the power charging credits from the customer to a user by automatically generating a block for a blockchain, the block indicating at least a user identifier of the customer, a user identifier of the user, and an indication of an amount of the power charging credits that are being transferred.

15. A computer program product, comprising:

one or more computer readable storage mediums having program code stored thereon, the program code stored on the one or more computer readable storage mediums collectively executable by a data processing system to initiate operations comprising:

detecting an in-store customer transaction;

assigning power charging credits to the customer based, at least in part, on the in-store customer transaction;

activating a charging station for the customer;

determining whether an amount of energy consumption by at least one user device of the customer from the charging station has reached a threshold value, the threshold value based, at least in part, on the power charging credits assigned to the customer; and

responsive to determining that the energy consumption by the at least one user device of the customer from the charging station has reached the threshold value, initiating the charging station to cease or reduce power being delivered by the charging station to the at least one user device of the user.

16. The computer program product of claim 15, the operations further comprising:

tracking a path of the customer with respect to locations of a plurality of charging stations at a facility;

determining that the charging station, from among those of the plurality charging stations that currently are available, is nearest to a current location of the customer; and

activating the charging station based, at least in part, on the customer remaining within a threshold distance of the charging station at least a threshold period of time.

17. The computer program product of claim 16, wherein the program code is executable by the data processing system to initiate operations further comprising:

generating an alert, presented on the user device, indicating to the customer the determined charging station is available for use by the customer to charge the device.

18. The computer program product of claim 15, wherein the program code is executable by the data processing system to initiate operations further comprising:

responsive to determining that the energy consumption by the at least one user device of the customer from the charging station has reached a threshold value, generating an alert on the user device that provides the customer with opportunity to purchase additional power charging credits.

19. The computer program product of claim 15, wherein the assigning the power charging credits to the customer comprises:

assigning the power charging credits to the customer using a distributed ledger.

20. The computer program product of claim 19, wherein the program code is executable by the data processing system to initiate operations further comprising:

wherein the assigning the power charging credits to the customer using the distributed ledger comprises automatically generating a block for a blockchain, the block indicating at least a user identifier for the user and an indication of an amount of the power charging credits assigned to the customer.

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